

# ILLINOIS MUSEUM

OF

## NATURAL HISTORY

### The Natural History of Illinois:

BULLETIN No. 1.

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## INTRODUCTION.

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**A**T the semi-annual meeting of the Board of Education of the State of Illinois, held at Normal, Ill., on the 15th of December, 1875, the following preamble and resolutions were unanimously adopted :

WHEREAS, Since the control of the Museum of the Illinois State Natural History Society was transferred to the State Board of Education, no general declaration has ever been made by this Board of the relations and policy of the Museum, or of the purposes of the Board concerning it ; and

WHEREAS, It seems desirable that the students and friends of science should know definitely and authoritatively the nature, scope and promise of the work of said Museum, in order that they may intelligently co-operate with its officers for the promotion of the scientific interests of the state : therefore,

*Resolved*, That we regard the Museum as a State Institution, devoted to the prosecution of a natural history survey of the state, to the encouragement and aid of original research, and to the diffusion of scientific knowledge and habits of thought among the people.

That we consider it an important part of its work to supply collections of specimens to the public schools, as far as this can be done consistently with its own general interests, and especially to provide all needed facilities for the instruction of teachers in natural history, and in the most approved and successful methods of teaching the same : and

That we cordially invite the co-operation of the scientists of Illinois, offering them the free use of its collections, library and apparatus, and assuring them that whatever may be contributed to its cabinets or its funds shall be used faithfully and impartially for the advancement of science throughout the state at large.

In pursuance of the first of the above resolutions, the issue of a series of publications has been undertaken, which it is intended to devote especially to the natural history of Illinois. These bulletins will contain original contributions to a knowledge of any department of the natural history of the state ; such compilations, synopses, and the like, as will bring together widely dispersed and virtually inaccessible published matter relating to the local natural history, placing it in manageable form, within reach of the ordinary student ; and papers of value on economical science.

Within these limits it is desired that the publication may be made the

organ of all Illinois naturalists, upon whose active aid the success, and especially the degree of usefulness, of the enterprise is, of course, almost entirely dependent.

It is believed that by thus limiting the undertaking to a special field in which our own naturalists may be supposed to be better able to work than any others, and to which they are more likely to devote themselves with ardor and success, all the advantages of a local stimulus to research may be gained without inflicting upon science any increase of the number of rival centers of publication of similar scope and purpose.

For the purpose of providing better facilities than now exist for the future prosecution of the work here outlined, it is necessary that complete collections of specimens should be made in all parts of the state, that a full and well-selected library should be brought together, and that these should be thoroughly organized for practical use. Contributions of specimens and books are therefore earnestly desired. These will be received at the Museum, properly cared for, promptly arranged, catalogued and indexed, and held for the use of any working naturalist.

S. A. FORBES,

*Curator Illinois Museum of Natural History.*

NORMAL, ILL., Oct. 16, 1876.

# BULLETIN

OF THE

## ILLINOIS MUSEUM OF NATURAL HISTORY.

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### NUMBER I.

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#### LIST OF ILLINOIS CRUSTACEA, WITH DESCRIPTIONS OF NEW SPECIES.

By S. A. FORBES.

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The following list is to be regarded as only a first contribution to the knowledge of our crustacea, as it presents the results of a single season's work. Considering the fact that, while our streams and pools are populous with interesting forms, many of which are new, only a single species outside the genus *Cambarus* has heretofore been credited to the state, it is hoped that even so imperfect a paper as this may not be without its uses.

I wish to acknowledge especial obligations to Professors A. E. Verrill and S. I. Smith of Yale College for specimens and for suggestions concerning the species of *Eubranchipus* and *Crangonyx* described herein, and to the latter of these gentlemen for many other favors.

*Cambarus acutus*, Gir. Very common in central Illinois. Taken in large numbers at Normal and Pekin. Of 25 males examined, the first abdominal legs were all those of Hagen's variety A. In none was the epistoma pointed, and a distinct lateral thoracic spine was present in but one. In twenty of the specimens the margins of the rostrum were distinctly convex from the base to the apical teeth; and the latter were in all much smaller than in Hagen's figures, the distance across the teeth being but one-fourth to one-third that across the base of the rostrum between the tips of the spurs. The tubercle in the basal foveola was elongated, notched in front and continued backward into a very slight cephalo-thoracic carina. Between the posterior callosities and the transverse line, the cephalo-thorax was finely rugulose. The females observed were also variety A.

*C. stygius*, Bundy. "Male. Rostrum long, triangular, smooth above, small teeth near apex, foveolate at base; carinae parallel, separated from base of rostrum by slight grooves; cephalo-thorax somewhat compressed, smooth or slightly punctate above, granulate on sides, areola narrow, smooth;

antennal plates wide, truncate at apex, apical teeth short; epistoma rounded in front, twice as wide as long; third maxillipedes hairy on inner sides, hands short, smooth above, serrate on inner margin, fingers short, straight, ribbed and punctate above, contiguous margins tuberculate, outer one hairy; third and fourth joints of third thoracic legs hooked; first abdominal legs short, truncate, enlarged towards apex, apical part recurved, then ending in three obtuse points turning outward, leaving a wide groove passing up on outer side behind teeth. The female has ventral ring flat, with posterior margin slightly elevated. Lake Michigan; washed up during a violent storm." (W. T. Bundy.)

*C. troglodytes*, Lec. This species I have not yet taken. It is mentioned here on the authority of Dr. Hagen.

*C. virilis*, Hagen. A few specimens have been collected at Normal, Cairo and Pekin, Ills., all young or of the second form except one male from Normal, which belongs to Hagen's variety A. The thorax is, however, broader and smoother, and the areola wider than in the typical form, which has been received from Rock river, Wis.

*C. wisconsinensis*, Bundy. "Male. Rostrum wide, narrower in front, straight, nearly plane above, foveolate at base, anterior teeth small, acumen short, acute; cephalo-thorax cylindrical, punctate, anterior margin not angulated, lateral tooth obtuse; dorsal area rather narrow, indistinctly defined; antennal plates longer than rostrum, greatest width in apical half; antennae slender, reaching to middle of abdomen; epistoma as wide as long, truncate in front; maxillipedes hairy on inner side and below at base; third joint of third legs hooked; first abdominal legs long, bifid, nearly straight, exterior part longer, tips slightly recurved; tips of interior parts recurved, acute, swollen near apex. Normal, Ill., and Racine, Wis." (W. T. Bundy.)

*C. placidus*, Hagen. "Quincy, Ill.," (Hagen.) I have not seen this species.

*C. propinquus*, Gir. Not common. Taken at Normal, Pekin and Freeport.

*C. immunis*, Hagen. This is the commonest species of central Illinois. It is especially frequent in the muddy ponds of the prairies, whence it may be drawn by the hundred with a small seine.

The general form of the rostrum of the young is the same as that of the adult; but more or less evident ante-apical teeth are present. The abdominal legs of the second form of the male are much thicker at the tip. In the first form the branches are slender and distinct throughout the distal half of their length, the outer branch is compressed at tip, and the inner depressed and widened a little, and channeled on the anterior surface. In the second form both branches are equally thick and strong, neither is compressed or channeled, and the two do not separate except at their tips after making the backward turn. The sudden thickening of the leg at its posterior middle is much less evident in the second form.

About one-fourth or one-half the specimens taken from stagnant ponds in midsummer are more or less completely covered above by the eggs of a species of *Corixa*,—probably *C. alternata*, Say, since this is much the



commoner of the two species found in such situations, the other being as yet undescribed.\*

These eggs are attached as closely as they can be placed, by the end opposite the micropyle, and do not seem especially to inconvenience their bearers.

The point of attachment preferred is the margin of the abdomen, out of the way of the legs; but the eggs are gradually extended along the sides of the cephalo-thorax until sometimes the body is almost entirely covered. A careful search of the weeds and other submerged objects in the ponds discovered no other place of deposit of these eggs. As these ponds usually go dry during the summer, it seems not unlikely that the *Corixa* may attach its eggs to the crawfish in order that the latter may, in such an event, carry them to other waters. It is not to be supposed, however, that the *Corixa* is entirely dependent on the crawfish for the preservation of its progeny, for the parent can fly, and is occasionally taken on the wing; nevertheless, this curious expedient must prevent a great waste of eggs, and so operate to the advantage of the species. But the subject requires further study.

*C. obesus*, Hagen. Very common. The largest in the state.

*C. gracilis*, Bundy.\* "Rostrum short, wide, depressed, concave above, acumen short; cephalo-thorax compressed, areola none, the pleura meeting on median line of dorsum, posterior spatium much wider than anterior; chelae long; inner margin tuberculate-serrate, fingers slender toward apex, outer one with strong tubercle on inner margin near base, movable finger with strong tubercle near middle of inner margin; carpus long, strongly toothed on inner, and lower front margins; third maxillipedes hairy on inner sides; third joint of third thoracic legs hooked; first abdominal legs of male truncate, with several small apical teeth, of which the inner one is much longest, slender and pointed outward, base of these legs inserted in deep sinuses in the strongly developed ventral part of first abdominal segment. Ventral ring of female movable: longitudinal fissure widest behind." (*W. T. Bundy*.) Very common along water courses in early spring. It was first detected by Prof. Bundy, in the museum collections, in the autumn of 1875, has since been taken in great numbers at Normal, and has been received by Prof. Bundy, from Racine, Wis.

*Palaemon ohionis*, Smith. Abundant at Cairo, where it is frequently eaten. Smaller specimens were taken in the Mississippi near Grand Tower, in Jackson county, and it is reported by boatmen to occur from St. Louis to New Orleans, growing larger towards the south. It has not yet been found in the Illinois River.

*Palaemonetes exilipes*, Stimp. Very common in the Illinois River, where it seems to be the only shrimp. Taken in large numbers at Pekin.

*Hyalella dentata*, Smith. Occurs in myriads in the swamps of the Calumet river, at South Chicago, and sparingly in Rock river, at Oregon, Ogle county. Not seen further south.

\*Uhler.

\*The descriptions quoted have been kindly furnished me by the discoverer of the species.

*Gammarus fasciatus*, Say. Apparently occurs throughout the state, in small rocky streams. Collected at Deer Park, La Salle county, in a small branch of the Vermilion, and in several streams in Jackson and Union counties. Scores of males and females were taken together under stones, on the 30th of July.

In specimens from southern Illinois, the hands of the first pair in both sexes bear stout spines on the distal half of the posterior margin in addition to those on palm and at the tip of dactyl. A short transverse row of long hairs is situated at the base of the median palmar spine. The inner side of the hand of the second pair in the male is ornamented with two longitudinal series of short transverse rows of hairs,—the posterior of five rows, the anterior of three. The palmar margin in the female has the lamellar edge. The lateral clusters of spines on the fourth posterior abdominal segment, in both sexes, each contain one very stout spine and several slender ones, while the median cluster consists of slender spines only. Each of the elusters on the fifth and sixth segments consists of two stout spines and several slender ones, except the median fascicle of the sixth segment, which consists of two distinct clusters of slender spines. The divisions of the telson have two clusters of hairs on the upper surface near the outer margin, of which the basal contains two spines. The spiny tips of the divisions are emarginate.

*Crangonyx gracilis*, Smith. Very common in central Illinois. Collected at Bloomington, from slow, shallow streams. These specimens differed in several small details from those described by Prof. Smith, the most important relating to the caudal stylets. In the typical form the tips of the three pairs are even; but in the Bloomington specimens the second pair extends farther back than the third, and the first farther than the second. The inner ramus of the last pair is sometimes unarmed, but oftener bears one or two spines at or near the tip. The length of ovigerous females is 10 mm.; of the largest males observed  $8\frac{1}{2}$  mm.

A form from southern Illinois represented in my collections by a few females, I cannot distinguish specifically from the above, although the second hands are proportionally longer and narrower and much more spiny, the anterior and posterior margins less convex, and the palmar margin more so. The tips of the caudal stylets reach the same perpendicular plane, and the inner ramus of the last is always as long as the width of the outer and bears one or two spines.

*Crangonyx mucronatus*, Forbes. This remarkable species is perhaps entitled to rank as the type of a new genus; but, until I have the material for a more general study of its relations than I am able to make at present, I prefer to place it with its nearest allies in the genus *Crangonyx*.

Colorless, blind; length 9 to 10 mm, width 1 mm. The head is a little longer than the first thoracic segment, its anterior margin concave at the bases of the upper antennae, convex between them; the posterior margin straight in the middle and curving forward on the sides. The front angles of the first thoracic segment are uncovered and produced a little forward; the hind angles of the first five segments are rounded and produced strongly backward. The first three abdominal segments have the lateral



margins and all the angles broadly rounded, and the posterior angles, as well as the posterior margin of the seventh epimeron, are slightly notched and bristled. The *upper antennæ* of the male are two-thirds to four-fifths as long as the body. The first and second joints of the pedicel are sub-equal, each about as long as the four basal joints of the flagellum; the third is one-third as long as the second. The flagellum is about five times the length of the pedicel, and is composed of 30 to 35 joints, each with a few short hairs at tip, and all except the seven or eight basal joints and the last with a slender olfactory club. The secondary flagellum contains two bristled joints, together a little longer than the first of the primary flagellum. Pedicel of *lower antennæ* longer than that of upper, the last two joints equal, each a little longer than basal joints of upper antenna. Flagellum nine or ten jointed, without olfactory clubs. Right *mandible* with dental laminae equal, each with five conical, obtuse, sub-equal teeth. The anterior lamina of the left mandible is much the larger and stronger, with three very strong, blunt teeth; posterior lamina with three slender and acute teeth. *Palpus* three-jointed; basal quadrate, about half as long as second, which is clavate and nearly twice as wide as long, with about ten long hairs on its rounded hind margin which are longest and closest distally. Last joint a little longer and narrower than second, regularly convex in front, straight on proximal half of hind margin, slightly concave on distal half, and fringed here with about 24 slender hairs, the three or four at tip becoming suddenly very much longer. A few scattered hairs on front margin of this joint.

Inner plate of anterior *maxilla* is nearly hemispherical, about half as long as outer, with four plumose hairs on the rounded margin, which are about as long as the plate itself. *Palpus* two-jointed, first quadrate, one-third as long as second, which is oval, pointed, tipped with two claws and some smaller spines. Laminae of basal joints of *maxillipeds* short, neither pair extending beyond tips of succeeding joints.

*First two pairs of feet* equal. Dactyl of first pair in male curved, two-thirds as long as *hand*. The latter is broad-ovate, two-thirds as wide as long, the palmar and posterior margins forming a wide angle. Long hairs on posterior surface in transverse rows. Palm with about fifteen short, notched spines, each with a hair arising from the notch. Carpus sub-triangular, three-fourths as wide as propodus, hind margin very short, with one or two pectinate spines and a few long hairs. Second pair similar, propodus a little longer and narrower; carpus as wide as propodus, posterior margin longer, with about five transverse rows of long bristles, of which the distal row are doubly pectinate on terminal third. The three posterior pairs of *thoracic legs* increase in size backwards, the first of these being not quite two-thirds as long as the last. The seventh epimeron is narrow, with the lower margin regularly arcuate. The tips of the first pair of *anal legs* extend beyond the tips of the second, and these beyond the tips of the third. The latter are therefore very short, about as long as the pedicel of the second pair. The outer ramus is ovate, truncate, half as long as the pedicel, and hairy at tip; the inner is an unarmed rudiment, one-fourth or one-fifth the length of the outer. The *telson* of the male is a smooth cylindrical

appendage, usually about as long as the first three abdominal segments, and as large as the last joint of the pedicel of the lower antenna. It presents a very slight double curve, is obliquely rounded at the end and tipped by a cluster of short hairs. In some cases this appendage is half as long as the body.

The female differs in the following particulars. The upper antennae are only about half the length of the body, the flagellum not more than three times as long as the pedicel, and the secondary flagellum is usually a little shorter. The propodus of the *first pair of feet* is similar in outline, but the palmar margin and dactyl are shorter and the posterior margin longer. The *second pair* are extremely like the second of the male, but are decidedly smaller than the first. The *telson* affords a difference so remarkable that the two sexes, at first sight, would hardly be referred to the same genus. In the female this is very similar to the telson of *C. gracilis*, Sm. It is flattened and slightly emarginate, a little longer than broad, extending to the tips of the second pair of anal legs, and bears two terminal clusters of spines of four or five each.

This species was first discovered by me in a well at Normal, Ill., during the summer of 1875. It was subsequently found by Mr. Harry Garman in great numbers in springs, and even at the mouths of drains, after a long period of heavy rains. With the advent of dry weather it entirely disappeared from these, but still occurs sparingly in wells.

*Asellus brevicauda*, Forbes. Length without caudal stylets, 10 mm. to 15 mm.; width, 3 mm. to 5 mm. Color as in *A. communis*. Head a little longer than first thoracic segment and about two-thirds as wide; anterior margin distinctly concave in middle and retreating each side, anterior angles distinct, sides straight, nearly parallel on anterior three-fourths.

The posterior fourth is produced on each side into a prominent lateral lobe bearing several stout spines. The distance to which this lobe projects equals half the length of the lateral margin of the head in front of it. The *eyes* are rather small but prominent, and are situated just within the middle of the straight portion of the lateral margin. The re-entering angle at the side of the head is a little less than a right angle, but its apex is rounded. The *thoracic segments* are sub-equal in length, of the usual shape, but becoming very concave behind. The concavity of the last segment amounts to more than half the length of the segment. The anterior angles of the first segment are deeply emarginate, the notch being nearly filled by the epimeron; but there are no other lateral emarginations in any of the segments, nor are any other epimera visible from above. In some young specimens the lateral margins of the two or three posterior thoracic segments are slightly sinuate. The hind angles are all rounded, and the free margins are all beset with long bristles, longest on the lateral margins and especially at the angles.

A short first *abdominal segment* is visible in the concavity of the last thoracic. The last abdominal is wider than long, with a broad rounded projection occupying the median half or two-thirds of the posterior margin, reaching half way or more to tips of pedicels of caudal stylets. The pos-

terior lateral angles are distinct though obtuse, the hind margin being somewhat concave each side the median lobe; and the margins are hairy as in the thorax.

The *upper antennae* are nearly as long as the pedicel of the lower. The flagellum consists of 11 to 13 joints, the two terminal together about as long as the preceding one. The three joints preceding the last bear, each at its anterior internal angle, a large olfactory club about as long as the eighth joint of the flagellum.

The *lower antennae* extend backward about to the base of the abdomen. The last joint of the pedicel is as long as the two preceding. The flagellum contains about 60 joints in the female and 90 in the male.

The *palpus of the mandible* is small, three-jointed, the first joint clavate, with three spines on the distal half of the posterior margin and one or two at tip. The second joint is about twice as long as wide, slightly concave in front and with a distinct median angle behind. There are two or three scattered hairs on the basal half of the posterior margin, and many long plumose hairs, shortening distally, on the terminal half. The third joint is ovoid, tapering, very broadly rounded in front and distinctly concave behind. The concave posterior margin bears a row of long plumose hairs, regularly lengthening toward the tip, and a sub-marginal row of shorter hairs on the side of the joint. The basal joint of the *palpus of the maxilliped* is very short, transverse, about three times as broad as long, with outer margin perpendicular to terminal. The second joint is a little broader than long, rounded slightly without, very broadly within, and plentifully ciliate on both edges.

The third joint is about two-thirds as long as second, broadly and regularly rounded within, narrowed about one-third at tip; the fourth clavate, incurved, as long as second, at tip about half as wide as long; the fifth about half as wide and long as fourth, incurved, obtuse. All the joints bear long marginal hairs.

The *first pair of feet* in the male are strongly sub-chelate; the propodus a little more than two-thirds as wide as long, the palmar margin straight, with one strong tooth at base and another at middle. The posterior margin is only about one-fifth the palmar, and perpendicular to it. The dactyl is strong, curved, serrate behind with about seven distinct teeth. The terminal claw is strong, acute and curved. Both margins of the propodus and the front of the dactyl are hairy: a cluster of longer hairs is seen near base of claw of dactyl.

The propodus of the female is a little narrower and the palmar margin is somewhat concave. The tooth at the middle of the palmar margin is smaller, but quite distinct.

The *basal abdominal plate* beneath in the female is obtusely triangular, about half as long as the basal part of the next plate behind. The first pair of *genital plates* in the male are long and narrow, the terminal joint truncate, strongly excurved beyond the middle, and bordered posteriorly by about six long bristles a third as long as the joint.

In the second pair of plates the basal joint (pedicel) is twice as long as



the rami and three-fifths as wide as long. The second joint of the outer ramus is ovate and twice the length of the first. The inner ramus reaches to the middle of this joint, is broader than in *A. communis*, but of similar shape, and indistinctly bifid at tip.

The *opercular plates* do not reach the tip of the abdomen, but are obliquely truncate, their posterior margins forming a wide re-entering angle. The *anal stylets* are very short, flat and broad. The peduncle is ob-triangular, nearly as broad as long, the tip oblique, the inner edge being the longer and somewhat rounded. The outer ramus is narrow-ovate, obtuse, as long as the peduncle, and seven-eighths the length of the outer ramus. This is also ovate and obtuse, the outer margin nearly straight, the inner convex. All the joints bear many marginal spines, longest at tips of rami.

This species was found in clear, rocky rills in Jackson and Union counties in Southern Illinois.

*Asellus intermedius*, Forbes. This species is more closely allied to *A. communis* than to *A. brevicauda*, but, as will be seen from the description, stands between these two. Its *length*, in adult females, is but 6 mm., its *breadth* about 2 mm. The sides of the *head* diverge posteriorly, and the lateral lobe is smaller than in *brevicauda*, bearing a single spine and a few short hairs. The first *thoracic segment* is narrowed anteriorly, showing the epimera, but is not emarginate. The others are distinctly emarginate on the sides, the emarginations moving gradually backwards, in the succeeding segments, from the anterior to the posterior angles. The free margins of all the segments are strongly spined. The lobe of the hind margin of the *abdomen* is shorter and broader than in *brevicauda*, reaching laterally to the middle of base of each caudal stylet, and extending backward to the middle of length of pedicel. The posterior angles of the abdomen are regularly rounded and indistinct.

The flagellum of the *upper antenna* is nine-jointed, the first joint short, about half as long as fourth.

The *first pair of feet* of the male are stout, the hand two-thirds as wide as long, the palmar margin straight, with a slender tooth at base and a strong conical one at middle. The posterior margin of the propodus is very short, about one-sixth the palmar, the daetyl long and strong, the tip of the claw when closed reaching beyond the base of the hand. The posterior margin of the daetyl is serrate with appressed teeth as in *brevicauda*. The carpus is triangular, the posterior margin straight and usually armed with a strong blunt spine at its distal fifth. The hand of the female is narrower and smaller, its breadth being about half its length. The palm is straight and shorter than in the male, the posterior margin longer, (nearly half the palmar), the two margins forming a wide angle. The spine at this angle is slender, and there is no trace of a tooth on the palmar margin, or on the carpus.

The first pair of *genital plates* in the male are short and broad, the basal joint scarcely longer than wide, the second joint elliptical, broadly rounded at tip and convex both sides, fringed posteriorly and on posterior half of outer margin by a few short hairs. The pedicel of the

second pair is about as long as wide, the rami are as long as the pedicel and sub-equal. The second joint of the outer ramus is elliptical and thrice as long as the first. The inner ramus is nearly half as wide as long, the basal processes obtuse and low, the outer one being almost obsolete. The outer terminal angle is prolonged into an incurved process, the inner provided with a movable (?) excurved claw.

The *caudal stylets* are flat and broad, but narrower than in *brevicauda*, about three-fifths as long as the abdomen. The width of the pedicel is two-thirds its length. The outer ramus is nearly five-sixths the inner and equal to pedicel. Both rami are narrow-ovate, and very obtuse, the inner about four times as long as wide and nearly straight on the outer margin. Both pedicel and rami are spiny on their margins, and the latter are tipped with a few long hairs.

Abundant in the hill-country of southern Illinois, under stones in small streams.

While these two species of *Asellus* were found in considerable numbers on the first day of my trip, I have never seen a specimen of either in the central or northern part of the state, although I have carefully searched the most varied situations.

*Asellus stygius*, Packard. This species has been peculiarly unfortunate. Described originally from an injured specimen, its structure and relations were misunderstood and it was made the type of a new genus, (*Caccidotea*, Packard). It was soon re-described by Prof. Cope, under the specific name *microcephalus*; and these imperfect descriptions have since been supplemented by several fragmentary notices in various papers by Packard and Smith.

With a view to giving a more coherent account of it, I have examined many specimens of both sexes and various ages, and have prepared the following description: A detailed comparison of this species with undoubted *Asellus*—especially with the admirable plates of *A. aquaticus* in the *Crustacea d' eau douce de Norvege*, has failed to reveal any structural peculiarities which could possibly serve as the characters of a distinct genus, and I have therefore united it to *Asellus*.

Colorless, blind, narrow, very loosely articulated, sides nearly parallel, 12 to 14 mm. by 2 to 3 mm.

The *head* is a little narrower and longer than the first thoracic segment, narrower in front than behind, with the front margin concave, the front angles rounded, the hind margin nearly straight. It is a little constricted behind the mandibles. The first *thoracic segment* is narrowed a little to the front so as to show the epimera, the sixth and seventh are also much narrower before than behind, and longer than the others. The front angles of the second and third segments are obliquely truncate, the hind angles broadly rounded. All the segments behind the first are slightly emarginate on the sides, the emarginations being carried gradually backward to the posterior angles. The anterior margins of the segments change gradually from concave to convex, and the posterior margins from sinuate to deeply concave. The head and all the segments are slightly pubescent above and bor-



dered laterally with short hairs. The large *abdominal segment* is preceded by two very short ones. The abdomen is about as long as the last two thoracic segments, the hind angles rounded but distinct, the hind margin very slightly sinuate.

The *upper antennae* reach to the tip of the penultimate joint of the pedicel of the lower. Pedicel and flagellum about equal, latter ten to twelve-jointed, bearing a slender olfactory club at tip of each of the four or five joints preceding the last. Joints of pedicel sub-equal in length, but the first twice as large as the second.

The *lower antennae* are about two-thirds as long as the body in the female, in the male somewhat longer. Pedicel about one-third flagellum, five-jointed, fifth and sixth joints each longer than the basal three together. The flagellum contains 75 to 80 joints. The *mandibles* are almost exactly as in *Asellus aquaticus*. The posterior dental plate of the left mandible is nearly as wide as the anterior. The hairs of the marginal fringe are more numerous on the right mandible than on the left, and the anterior eight are toothed instead of plumose.

The *mandibular palpus* is slender, the basal joint a little shorter than the second. On the latter the external angulation is considerably behind the middle. The distal joint is narrow, lunate, (distinctly concave on outer margin) about five-sixths the length of the preceding joint, with about 20, jointed, plumose, marginal hairs, similar to those on the distal half of outer margin of preceding joint. The two plates composing each *maxilla* of the *first pair* are equal in length. The inner is three-fourths as wide as the outer, terminating in five plumose hairs. The outer terminates in twelve strong spines, of which the five outer are stronger and simple, and the seven inner irregularly and bluntly toothed near their tips. The *posterior maxillae* as in *Asellus aquaticus*. The shorter internal hairs on the two outer plates are expanded transversely to the plane of the plate and hollowed lengthwise on the inner face, giving each hair the form of a racing-shell, while both edges of the hair are coarsely toothed. The basal joint of the *palpus of the maxilliped* is quadrate, the fourth joint is about as long as the second and third together. The inner margins of the fourth and fifth are provided with very long hairs. The flagellum (*fouet*, Sars.) is as broad as long, with about eight scattered hairs at tip and several shorter ones on external margin.

The propodus of the *first pair of feet* in the male is very large, broad-oval, two-thirds as wide as long. A strong curved spine is situated at the proximal end of the palm, and two truncate, stout teeth separated by a rounded emargination, near the distal end. The dactyl is strongly curved, especially at base, its inner edge serrate with six acute teeth appressed towards tip. The length of the terminal claw is more than one-third that of the entire dactyl. The convex margin of the dactyl bears a few scattered hairs, and a cluster of four or five near the tip. The carpus is small as in *A. aquaticus*, and spined on its distal margin. The female hand is smaller and narrower, (width to length as 1 to  $1\frac{1}{4}$ ) the palmar margin concave, the pair of truncate teeth replaced by a single smaller conical one which is sometimes obsolete. The other differences are trivial. The *legs* become longer

behind, the tip of the second pair reaching as far as the base of the propodus of the seventh. The *abdominal sexual plates* of the male are in two pairs, as usual. (See plate). The corresponding plates of the female are but one pair, rather narrowly ovate, ciliated at tip and on posterior two-thirds of outer margin, with a few short spines at the base of the inner edge. The external ramus of the next pair—serving as a gill-cover—bears a terminal fringe of plumose hairs and a few short spines at base on outer margin. The inner ramus—first gill—is oblong, two-thirds the length and breadth of the outer. Both the pedicel and rami of the *caudal stylets* are slender and cylindrical, the former about as long as the last two joints of the last pair of legs, the latter tipped each with a cluster of bristles, the inner about two-thirds as long as the pedicel, the outer varying from one-quarter to two-thirds the inner. The length of the rami varies greatly with age and sex. In many old males the inner is very long and the outer minute. There are four pairs of *incubatory lamellae* in the female, each pair overlapping by their rounded inner ends, except the first, which are shorter and have the anterior internal angles emarginate.

The description has been given above in greater detail than would otherwise have been necessary, in order to settle the question of genus. The species is found quite frequently in deep wells of central Illinois, in company with, but much more abundant than, *Crangonyx mucronatus*.

After a long period of heavy rains during the last summer had greatly swelled the subterranean streams which these species inhabit, they appeared at the surface in springs, and even at the mouths of tile drains, in such numbers that a hundred could be taken in an hour. A few females were observed with eggs at this time. (July).

*Eubrachipus serratus*, *Forbes*. This species seems to replace the *E. vernalis*, *Verrill*, of the Eastern States, to which it is closely allied. An important character, constant in the large number of both sexes which I have examined, is found in the *abdominal segments*, which are narrowed in front, with rounded anterior angles, while the posterior angles are produced backward, giving a decidedly serrate appearance to the abdominal margin. The last two abdominal segments are closely united and broader than the preceding.

The *antennae* extend a little beyond the eyes, and terminate in a cluster of about five slender olfactory clubs. The *frontal appendages* of the male are considerably longer than the claspers, to the front inner base of which they are attached, the line of attachment being parallel to the length of the basal joint. Their form is irregularly oval, the inner edge being regularly convex on its distal three-fourths and the outer sinuate—convex on basal two-thirds, and slightly concave on terminal third. Both margins are pectinate, except near base, with thick blunt teeth, which are longest on the basal half of the outer margin, where they are as long as the undivided part of the appendage is wide. At the middle of this margin the teeth become suddenly shorter. On the inner margin they are longest near the middle, regularly lessening towards each end. The under (posterior) surface of the appendage, as well as the teeth, is set with short spines, each springing from an inflated

base. The *claspers* of the male are shorter and stouter than in *E. vernalis*. The basal joint is soft and inflated and bears a corneous rounded tubercle at its inner base.\* The second joint is stout and regularly incurved, strongly angulated at its base in front where it is received into the first joint. A long strong tooth, about half as long as the joint, extends backward and a little inward from near its base. The rounded tip of this tooth is thickly set with minute, low, circular elevations, each with a central depression, within which is a disk-like elevation, the whole having the appearance of a minute sucking disk. The tip of the clasper is expanded and flattened within so that the inner (anterior) part has a spatulate form, while the opposite surface rises into a thick prominent ridge, giving to a transverse section of the tip the form of the letter T. The *anal appendages* are linear-lanceolate, as long as the last four segments of the abdomen, and plumosely haired to the base. The ovisae of the female is as broad as long, three lobed behind with the middle lobe the largest.

Length of a full grown male, including anal stylets, 20 mm., width 6 mm., across eyes 4 mm., clasper 4.5 mm., frontal appendage 5 mm. by 3 mm. The largest females were a little more slender than the males. This species was first observed at Normal, Ill., in clear pools, in April, 1876. About a fortnight afterward it entirely disappeared. Another species has been sent me by Prof. Bundy, by whom it was taken in Wisconsin.

*Canthocamptus illinoisensis*, Forbes. Length 1 mm., color light red. Head and first segment united; five abdominal segments in male, four in female. The suture between the first and second segments is not wholly obliterated above in the female.

*Last abdominal segment* is deeply and acutely emarginate. Branches of *furca* as wide as long, inner bristle plumose, a little longer than abdomen; outer plumose only on outer side, about half the length of the inner. The second to fifth *abdominal segments* have each a row of spinules along ventral portion of posterior margin.

Male with *anterior antennae* composed of seven joints, the fourth joint very short. The front outer angle of the third is produced, the blunt process bearing three long bristles surrounding a slender olfactory club which is as long as the three following joints. The penultimate joint bears a strong spine or slender appressed process at the middle of its posterior margin. The five outer joints constitute the grasping organ. The *posterior antennae* bear five long bristles at tip, three of which are made prehensile by the occurrence of from eight to twelve short articulations in the middle of the hair, allowing it to be bent forward. At the base of these articulations on the outer bristle, are two short spinules. Two nearly longitudinal rows of five or six strong, short spines each appear on the under surface of the outer joint of the antennule. The secondary flagellum, borne as usual on the middle of the basal joint, is not articulated, and bears four long bristles, two terminal and two on distal half of inner side. The outline of the *mandible* is exactly like that figured by Claus, but it bears about ten teeth, the upper thick and blunt, the inner sharp, slender and longer. Several are notched

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\*Wanting in *vernalis*



at tip. The lower angle bears a long simple bristle. *Mandibular palpus* two-jointed, second joint with three long terminal hairs and a shorter spine attached at basal third of anterior margin, jointed at base and directed towards tip of joint, like a daetyl. The *maxilla* and *maxillary palpus* are scarcely to be distinguished from those of *C. staphylinus*.

The first maxillipeds are three lobed, the outer lobe constituting a long, strong claw. The second and third are about one-third as long as the first, and bear each one strong simple spine and one weak branched hair. The inner lobe is widest, about two-thirds as wide as long. The daetyl of the *posterior maxilliped* is spinous on its inner edge, and the same edge of the hand is ciliate and bears a short, stout, sparingly plumose bristle at its base, just beyond the tip of the closed daetyl. The width of this joint (the second) is nearly half its length.

Basal joint of inner ramus of *first pair of legs* nearly or quite as long as outer ramus, the second wider but only half as long as the third, and obliquely truncate. Inner ramus of *third pair of legs* in male is three-jointed, the outer two-jointed, chelate. The finger is ovate, truncate, terminating in two long plumose hairs. The daetyl is linear, curved at base, and twice as long as finger. The inner ramus of the *fourth pair of legs* is about half as long as outer, two-jointed, basal joint short, terminal joint about as long as middle joint of outer ramus. The *fifth pair of legs* is best developed in the female. In the male the length is not over one-third the width. The basal portion bears three plumose hairs on its very broadly rounded anterior margin, of which the innermost is longest. The outer plate is nearly orbicular and bears five spines on its terminal margin, of which the second from the internal angle is the longest. *Genital plates* found in male at posterior border of first abdominal segment, beneath, are short, slightly expanded internally, with internal angles rounded, and externally bear three sub-equal bristles, jointed at base, the inner largest and strongest and semi-plumose. The *antennae* of the female are eight-jointed, extending backward to the first free segment. The basal joint of the *fifth pair of legs* is sub-elliptical in outline, with the basal half produced externally into a broad, triangular process which bears the second joint on its posterior margin. The free end of the basal joint bears six large plumose bristles of which the inner is longest. The greatest width of the joint is nearly equal to its greatest length. The second or outer joint is ovate, sub-truncate, spined on each margin, and bears four plumose bristles at tip and one at the middle of its outer margin. Its length is about twice its breadth. Same habitat as the following :

*Diaptomus sanguineus*, *Forbes*. This species differs in some slight respects from the genus to which I have assigned it, as characterized by Claus, (*Die Frei Lebenden Copepoden*) but not sufficiently to constitute it a new genus. In the male the fifteenth to eighteenth joints of the right antenna are thickened, the teeth of the mandible are not at all emarginate, the first joint of the terminal portion of the lower maxilliped is smaller than the others, and the right foot of the fifth pair in the male wants the inner ramus, which is perhaps represented by an immovable blunt spine at the

inner inferior angle of the second joint. The *body* of this species is broader than in *D. castor*, the color is throughout a deep red. The *antennae* are nearly as long as the body, the eighteenth joint in the female reaching to the base of the abdomen. The second tooth of the *mandible* is larger than any of the remaining six of the series, and is separated from the third by an interval equal to the width of the tooth. A short feathered bristle appears at the lower end of the row of teeth. The secondary appendage of the *mandibular palpus* is four-jointed, and bears six bristles at its tip and inner margin. The *maxilla* has the normal structure, the basal plate, the two cylindrical processes and the outer ramus (flabellum) and the inner ramus being all present and symmetrically developed. The *first maxilliped* is nearly as broad as long, and bears 15 long hairs on its margin. The basal segment of the *second maxilliped* presents four rounded processes on its inner margin, of which the first is smallest and bears one bristle, the second and third are subequal and bear respectively two and three bristles, and the fourth is largest, is much produced inferiorly (the rounded lower end being finely ciliate) and bears four bristles.

The *fifth pair of legs* in the female is bi-ramose, the inner branch straight, slender, not jointed, terminating in two short claws; the outer strong, two-jointed, terminating in a single slightly serrate claw. The second joint of this branch bears two slender bristles near the middle of the outer margin, otherwise the leg is destitute of hairs and spines. The *legs of the fifth pair* in the male are very dissimilar. The right leg consists of five joints; the basal quadrate; the second about twice as wide as long, enlarging distally and bearing a strong blunt spine at the inner, and a longer one at the outer, inferior angle. The third joint is sub-quadrate, the fourth clavate, bearing a long bristle at the middle of its outer margin; and the fifth constitutes a slender incurved dactyl as long as the preceding joint, slightly serrate on the distal half of its inner margin, and so jointed as to close back against the inner margin of the fourth joint, which thus acts as a hand. The left leg reaches about to the tip of the third joint of the right. Its pedicel contains two large quadrate joints; the outer ramus two small joints, of which the terminal one is forcepate at the tip, the inner ramus a single slender joint on which no armature was seen. The *furca* bears at tip of each branch four long feathered hairs, and a fifth smaller simple one at the posterior internal angle. A sixth large and plumose hair is borne at the posterior third of the outer margin.

Found rather abundantly in a pool fed by a slow spring, in March and April, at Normal, Illinois. In several characters, especially those of the mouth appendages, this species seems closely allied to *Ichthyophorba*, bearing to some species of that genus a much closer resemblance than to *D. castor*, if the figures in Baird's British Entomostraca are at all to be relied on.



## KEY TO THE SPECIES MENTIONED IN THE PRECEDING PAPER.

The general neglect of our crustacea by the students of our local natural history, if not a discredit, is at least a misfortune: for no other class of animals accessible to the inland student will repay study so promptly and so generously; since while the species are comparatively very few, they present many and extreme diversities of form and structure. The differences between the *orders* of this class,—between the *families*, even, of some of the orders,—are more profound, penetrate farther into the interior of the animal, affecting structures commonly far more stable, than do the differences between the other *classes* of the sub-kingdom. In the same order hearts may be present or absent, in the same tribe gills may be filamentous or lamellate, in the same genus so complex an organ as the eye may be well-developed or entirely wanting; and everywhere not external form alone seems plastic, but internal structure also. Indeed, this is but an instance of a more general truth. In every well founded sub-kingdom the lowest class stands nearest the point of common origin,—illustrates, therefore, most closely by its diversities the first divergeneies of the group from which the later groups have sprung. In this primeval group structure must have been much more unstable than in the later higher ones, else the stable structural characters which now distinguish classes could never have arisen; and in the lowest present class, which has departed least from the condition of this primeval group, this instability of structure may be expected to persist,—structural differences will have less “value” for purposes of classification.\* Hence in the study of the few examples of this lowest class of arthropods, we rapidly acquire a more fruitful knowledge of nature’s multiform adjustments, encounter more numerous and suggestive illustrations of her general laws, than by much longer and more elaborate study of the higher groups. For the amateur and the beginner the crustacea have further a peculiar interest from the fact that the transparency of some of the smaller forms makes possible the direct and easy study of the entire living organism. Nothing better could be devised for the luminous demonstration of the leading facts of animal physiology. In a single colorless *Asellus* or *Crangonyx* may be observed at leisure, under a low power of the microscope, the respiratory movement, the circulation of the blood, the motions of the heart and the actions of its valves, the contraction and relaxation of muscular fiber, the processes of digestion, as well as the general and minute anatomy of the entire animal.

The economical interest of the subject should not be overlooked. With the progressive settlement of the country we must look forward to a continuous advance in the price of animal food, and with this advance the question of our inland fisheries will rise yearly into higher prominence. But intelligent measures for the increase and preservation of our edible fishes

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\*This principle, that *structural characters diminish in importance downward*, has been ignored, I think, by some of our recent ichthyologists.

presuppose an acquaintance with the natural history of our crustacea, which are as essential to fishes as insects are to birds.

With a view to removing some of the many difficulties which have prevented a more general study of this captivating and important class, I add to the foregoing paper the following simple synopsis of the species mentioned, which it is hoped that any intelligent student may use successfully. It is of course a mere compilation designed as a temporary aid to local students. A few species from Lake Michigan have been included which have not yet been found within the limits of the state, but which must nevertheless occur there at least occasionally.

## CLASS CRUSTACEA.

Arthropoda usually with jointed abdominal appendages and two pairs of antennae. All save a few minute forms with more than four pairs of legs. Respiration by distinct gills, by gill-feet, or by the general surface of the body.

### ORDER DECAPODA.

Head and thorax consolidated, forming a cephalo-thorax ; eyes compound, on flexible stalks.

#### FAMILY ASTACIDAE.

Abdomen depressed, carapace (1) with a transverse channel, edge united with the epistoma (2) ; gills very numerous, composed of filaments ; the three front pairs of feet chelate (3), the first much the largest.

#### *Genus Cambarus.*

The fifth pair of legs without gills ; last segment of thorax movable. Rostrum (4) simple or with one tooth on each side. First abdominal legs of male (5) more less divided.

a

Oblique tubercle on front margin of third joint of third and fourth pairs of legs of male.

*C. acutus*, Girard. Areola (6) much wider behind than before. Thorax densely tuberculate on sides, nearly smooth above. Movable finger much longer than inner side of hand.

*C. troglodytes*, Leconte. Areola narrower behind than before. Thorax granulate on sides, strongly punctate above. Movable claw not longer than hand.

aa

Oblique tubercle on third joint of third pair of legs of male, none on fourth pair.

b

First abdominal legs of male not distinctly bifid.

*C. gracilis*, Bundy. Rostrum broad, short, toothless ; finger not hairy ; first abdominal leg toothed but not recurved at tip.

*C. stygius*, *Bundy*. Rostrum long, triangular, with small apical teeth; outer margin of finger hairy; first abdominal legs recurved at tip and three-toothed.

bb

First abdominal legs of male distinctly bifid.

c

*C. obesus*, *Hagen*. First abdominal legs short, thick, branches stout, tips recurved, obtuse. Areola linear.

cc

First abdominal legs of male with branches usually long and slender.

d

*C. immunis*, *Hagen*. Both branches gradually, strongly and equally recurved. Rostrum short and conical.

dd

Branches not strongly and equally recurved.

e

*C. propinquus*, *Girard*. Rostrum carinated (7) on middle of anterior half.

ee

Rostrum not carinated.

*C. placidus*, *Hagen*. Rostrum excavated, margins thickened; maxillipeds not hairy beneath; greatest width of hand contained about three times in length of outer margin, inner edge of outer finger not bearded, forearm without two rows of distinct spines beneath.

*C. virilis*, *Hagen*. Rostrum sub-excavated, margins thickened, hardly converging; antennal plates not longer than rostrum; maxillipeds bearded without, beneath and within; greatest width of hand about two and one-third times in length of outer margin, outer finger bearded within, forearm with two rows of distinct spines beneath.

*C. wisconsinensis*, *Bundy*. Rostrum nearly flat above, narrowed in front; antennal plates longer than rostrum; maxillipeds hairy within and below at base.

#### FAMILY PALAEMONIDAE.

Abdomen compressed. Carapace without transverse channel, its lower edges free throughout. Gills composed of plates. The third pair of feet never chelate.

##### *Genus Palaemon.*

Rostrum long, compressed, serrate; two inner antennae with flagella (8), mandibles (9) with three-jointed palpus (10), first pair of legs slender, second stronger, both chelate.

*P. ohonis*, *Smith*. Rostrum slightly curved upward at tip, about twelve teeth above and three to five below. Hand of second pair of legs about once and a half the length of the carpus (11).

##### *Genus Palaemonetes.*

Differs from *Palaemon* by the absence of mandibular palpi

*P. exilipes*, Stimpson. Rostrum nearly straight, seven or eight teeth above, one or two below. Hand of second pair of feet about two-thirds as long as carpus.

#### FAMILY MYSIDAE.

Feet more than five pairs, slender, often bearing palpi, none chelate, usually rudimentary on the abdomen. Gills wanting.

#### *Genus Mysis.*

Six pairs of thoracic feet, each with two many-jointed branches; three pairs of maxillipeds (12). Inner antennae with two flagella. Fourth pair of abdominal legs in male very long, styliform, directed backwards.

*M. relicta*, Loven. Cephalo-thorax about one-third total length, broader behind than before. Pedicel (13) of inner antennae a little longer than the eyes, three-jointed, first joint about as long as second and third together. Inner flagellum shorter and more slender than outer.

#### ORDER AMPHIPODA.

Body commonly compressed, of fourteen segments; thoracic segments not consolidated, eyes sessile if present. Gill plates thoracic.

#### FAMILY ORCHESTIDAE.

Upper antennae shorter than lower, no secondary flagellum (14). No palpus to mandible. Epimera (15) large. Last pair of abdominal legs not branched.

#### *Genus Hyalella.*

First two pairs of feet sub-chelate (16), the second the larger; upper antennae as long as peduncle of lower; telson (17), short, stout, entire; palpus of maxillipeds five-jointed; first pair of maxillae with very short one-jointed palpi.

*H. dentata*, Smith. First and second abdominal segments with a prominent tooth on middle of hind margin, second band of male about three times as broad as first, flagellum of lower antenna commonly but little longer than that of upper.

#### FAMILY LYSIANASSIDAE.

Body little compressed, first two pairs of feet small and weak, epimera of first four segments very deep.

#### *Genus Pontoporeia.*

Upper antennae with short secondary flagellum; first two pairs of legs very short, the first sub-chelate, the second not, seventh pair with basal joint very large.

*P. hoyi*, Smith. First pair of hands with one to three small slender spines at tip of closed claw. About seven elongated papillae on the second to fifth segments of the sternum (18). Upper antennae short, about as long as head and first three thoracic segments; flagellum about nine-jointed.

*P. filicornis*, Smith. Upper antennae reaching nearly to tip of abdomen, flagellum of about thirty-three joints, the terminal ones very long and slender. Secondary flagellum of four segments.

## FAMILY GAMMARIDAE.

Both antennae well developed, the upper long, slender, filiform, usually immediately above the lower, which are inserted into a notch at the front angle of the head. First and second feet sub-chelate. Eyes compound, commonly between upper and lower antennae.

*Genus Gammarus.*

No rostrum. Three last abdominal segments each with two or more clusters of short stiff spines on hind margin. Secondary flagellum and mandibular palpus present. Last pair of abdominal legs two branched; telson double.

*G. fasciatus*, Say. Secondary flagellum as long as second segment of peduncle (19), and composed of five or six segments. Fourth, fifth and sixth abdominal segments each with three clusters of spines on hind margin.

*Genus Crangonyx.*

No clusters of spines on posterior abdominal segments. Telson single; last pair of abdominal legs with inner branch rudimentary or wanting. Peduncles of the two pairs of antennae sub-equal. The first two pairs of feet sub-equal.

*C. gracilis*, Smith. Eyes evident. Hind angles of first three abdominal segments each ending in a sharp tooth. Outer branch of last pair of legs about twice as long as peduncle; inner branch very small. Telson short, emarginate.

*C. mucronatus*, Forbes. No eyes. Hind angles of first three abdominal segments rounded. Outer branch of last pair of legs shorter than peduncle, inner minute. Telson of male a slender spine about as long as first three abdominal segments.

## ORDER ISOPODA.

Body commonly depressed: thoracic segments not consolidated; eyes, if present, compound, sessile. Gill plates beneath abdomen. The last four pairs of thoracic legs similar, and differing from the first three pairs. Last pair of abdominal legs more or less styliiform.

## FAMILY ONISCIDAE.

Abdomen many-jointed, last segment small, caudal stylets (20) well exerted. Mandibles without palpi. Inner antennae obsolete.

## FAMILY ASELLIDAE.

Body very flat, loosely jointed. Last abdominal segment very large, shield-like, comprising nearly the whole abdomen. Upper antennae short, lower very long. Only first pair of feet sub-chelate. Mandibles with palpi.

*Genus Asellus.*

First pair of feet sub-chelate; last thoracic legs not elongate; first pair of abdominal appendages in female (first two pairs in male) small, forming short plates; outer ramus of next pair serving as gill-covers; caudal stylets elongate.



*A. brevicauda*, Forbes. Head with hind angles laterally extended, forming broad spinous lobes; front angles of first thoracic segment notched, no lateral notches on thoracic segments; tip of abdomen with broad rounded lobe, pedicels of caudal stylets as broad as long, palm of hand with two strong spines.

*A. intermedius*, Forbes. Head with small lateral lobes. First thoracic segment with front angles entire, others notched laterally; hind angles of abdomen not distinct, pedicel of caudal stylet twice as long as wide.

*A. stygius*, Packard. Slender, loosely-jointed, colorless and blind; caudal stylets slender, cylindrical, abdomen not lobed behind.

#### ORDER PHYLLOPODA.

Feet, ten to sixty pairs, broad and flat, two or three-lobed; mouth with mandibles and maxillae, antennae usually small, not used for swimming.

##### FAMILY BRANCHIPODIDAE.

Body long and slender, no carapace, thoracic segments distinct, eyes on stalks, second antennae converted into elapsing organs. Eleven pairs of gill-feet. Female with egg-pouch at base of abdomen.

##### *Genus Eubbranchipus.*

Head large, claspers (21) of male thick and strong, with a tooth at base of second joint; a pair of simple, flat, serrate, membranous appendages attached to front of head; caudal appendages long, lanceolate, with many feathery hairs. Egg-pouch short, thick, broad-oval.

*E. serratus*, Forbes. Frontal appendages longer than elaspers, irregularly ovate, deeply serrate. Tip of claspers flattened within, abdomen somewhat serrate.

##### FAMILY ESTHERIADAE.

Compressed: head and body enclosed in a bivalve shell. Eyes sessile; feet, ten to twenty-seven pairs.

##### *Genus Limnetis.*

Shell circular, globose, no beaks or lines of growth. Inner antennae two-jointed; feet ten or twelve; abdomen truncate.

#### ORDER CLADOCERA.

Body enclosed in a bivalve shell, head free; abdomen acutely forked; eye single, large. Lower antennae form large branched swimming organs; feet four to six pairs.

##### FAMILY DAPHNIADAE.

Upper antennae minute, one or two-jointed: five pairs of feet, all enclosed by carapace. Intestine nearly straight.

#### ORDER OSTRACODA.

Biting mouth, one eye, two pairs of antennae, one for swimming; bivalve carapace enclosing head and body. Feet one to three pairs.

## FAMILY CYPRIDAE.

Upper antennae long, many-jointed, with a tuft of long hairs: lower stout and foot-like; two pairs of feet.

## ORDER COPEPODA.

Body more or less distinctly segmented, and distinguishable into regions; two pairs of antennae, one or two antennae often prehensile. No carapace or bivalve shell; three pairs of mouth-parts and five pairs of swimming feet. Females with external egg-sac.

## FAMILY CYCLOPIDAE.

Both anterior antennae modified for grasping in male. Posterior antennae four-jointed, not branched. Fifth pair of legs cylindrical, alike in both sexes. One eye, with two lateral lenses; two egg-sacs.

*Genus Cyclops.*

Body broad in front, slender behind, of ten segments in males, nine in females. Head and first thoracic segment consolidated. Palpus of mandible rudimentary, a tubercle bearing two bristles. Fifth pair of feet obsolete.

## FAMILY HARPACTIDAE.

Body linear, cylindrical. Both anterior antennae of male modified for grasping. Posterior antennae branched, and armed with jointed bristles. The fifth pair of feet usually lamellate. Eye single. Commonly a single egg-sac.

*Genus Canthocamptus.*

Branches of the first pair of feet similar, three-jointed, the inner branch the longer, its first joint very long. Palpus of mandible simple, two-jointed. First antennae eight-jointed. Secondary branch of second antennae very short, one or two-jointed.

*C. illinoisensis, Forbes.* Minute, light red: five abdominal segments in male, four in female. Branches of furca (22) as wide as long. Of the bristles at their tip, the inner is about as long as the abdomen, the outer half the inner. Mandible with about ten teeth.

## FAMILY CALANIDAE.

Body elongate: anterior antennae very long, usually of twenty-four or twenty-five joints. In males the right—rarely the left—is modified for grasping. Posterior antennae large, two-branched. One egg-sac.

*Genus Diaptomus.*

Fifth pair of feet unlike in males, inner branch of right foot rudimentary or wanting. This foot is converted into a grasping organ, as is also the right antennae of the male. Antennae twenty-five jointed. Fifth thoracic segment distinct. Abdomen of male with five joints, of female with four.

*D. sanguineus, Forbes.* Color crimson. Right foot of male without inner ramus, the last two joints forming a hand and dactyl. Each branch of the furca bears six plumose hairs, of which the inner is slender and short. The teeth of the mandible are entire.

1. The crust covering cephalo-thorax on back and sides. 2. Under surface of head between the lower antennae. 3. Furnished with nippers. 4. Projection from front of head, between antennae. 5. In the male crawfish the first abdominal legs are stiff and unlike the others; in the female similar to the others, but rudimentary. 6. Space on back of thorax between the two longitudinal curved lines. 7. Ridged longitudinally. 8. The many-jointed terminal part of antennae. 9. Front pair of jaws. 10. Jointed feelers. 11. Joint preceding hand. 12. Hind pairs of jaws. 13. The thick, longer-jointed basal part of antennae. 14. A very short flagellum attached beside the principal one. 15. Side-plates concealing attachment of legs. 16. Last joint claw-like, shutting against the enlarged preceding joint like the blade of a pocket-knife against its handle. 17. Rudimentary last segment of the body. 18. Under surface of the body between bases of the thoracic legs. 19. Undivided basal joint of leg. 20. Pair of appendages at tip of abdomen. 21. The strong, jaw-like organs in front of head. 22. The forked tip of the abdomen.

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## APPENDIX.

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Descriptions of the following extra-limital species are added for the purpose of calling the attention of collectors to them, as it is very likely that they will be found in the state. The descriptions of crawfishes are furnished by Mr. Bundy, who has made a careful study of the species of *Cambarus* found in this and adjoining states.

*C. sloanii*, Bundy. Rostrum quadrangular, subdeflexed, slightly concave, toothed in front, acumen long, acute, straight, cephalo-thorax, finely punctate above, granulate on sides, front margin angulated, lateral tooth long, acute; epistoma wider than long, narrower in front, concave below, apex emarginate: third maxillipedes smooth below, hairy within, hands short, thick, wide, smooth, fingers short, straight, not gaping at base, generally tipped with black, arm and wrist nearly smooth, at most with a few blunt teeth; third legs with third joints hooked: first abdominal legs short, bifid, outer part slightly longer, flattened, bent outward at apex, slightly recurved, acute, tubercles at inner base small, inter-pedal space once and one-half longer than wide. The female has ventral ring rhomboid, posterior angle swollen, irregularly tuberculate, fissure transverse, anterior angle depressed. Habitat: Southern Indiana, Kentucky (*Dr. Sloan*).

*C. debilis*, Bundy. Rostrum wide, quadrangular, subdepressed, concave above, foveola at base, margins nearly parallel, anterior teeth prominent, acumen acute, flat, smooth, cephalo-thorax subdepressed, punctate above, granulate on sides, lateral tooth acute, dorsal area narrow, wider behind,

antennal plates longer than rostrum, apical spine acute; antennae slender, long, reaching to base of telson, epistoma much wider than long, truncate, maxillipedes barbate on inner side and below: inner margin of hand and movable finger with two rows of teeth, contiguous margins of fingers tuberculate, exterior one hairy at base, both fingers ribbed and punctate above, third joint of third thoracic legs hooked; first abdominal legs long, bifid, nearly straight, exterior part longer, recurved, interior part recurved, obtuse, not enlarged near apex, tubercles on inner basal angles small. This species resembles the above, but differs from it in having a wider, more concave rostrum, with parallel sides, a depressed dorsum, wider epistoma, more coarsely bearded maxillipedes, longer abdominal legs, and the absence of enlargement near apex of interior part. Habitat: Baraboo river, Ironton; Wisconsin river, Sauk City, Wisconsin.

*Eubbranchipus bundyi*, Forbes. This species, sent me by my friend Prof. Bundy, was taken by him at Jefferson, Wis. The specimens seen were somewhat smaller than average individuals of *E. serratus*, the thorax shorter and the abdomen more slender. The latter is similar to the abdomen of *E. vernalis*, while the claspers and frontal appendages are more like those of *E. serratus*.

The antennae extend about one-third their length beyond the eyes. The frontal appendages are long and narrow, widest at base and regularly tapering, serrate within and on outer margin of tip with short blunt even teeth. The under surface is covered with short blunt spines or tubercles.

These appendages are attached by a transverse line to the front of the head, just within the base of the claspers, and are about three times as long as the basal joint of the latter.

The claspers resemble in size, general form and position those of *E. serratus*. The tubercle at the base of the first joint is larger and situated farther forward, extending far enough to the front to meet its fellow of the opposite side before the labrum. The opposed edges are somewhat roughened. The labrum is large and extends forward in the form of a stout tubercle, truncate at its extremity. This process is embraced by the concave posterior internal margins of the basal tubercles of the claspers. The second joint of the clasper is thick at base, but tapers more rapidly than in *E. serratus*. The long and slender tooth of the latter is replaced by a thick rounded tubercle extending directly inward and covered by elevated disks, or truncate papillae, like the tip of the tooth in the species just mentioned. Unlike the latter, these papillae are wanting at the tip of the joint, which is expanded and distinctly bifid.

The margins of the abdomen are not distinctly serrate, the last segment is not connate with the penultimate, nor is the tip of the abdomen broader than the preceding segments.

The caudal stylets are broad and blunt, not rounded at base, usually a little longer than the last three abdominal segments, and ciliate their whole length. The ovisac of the female is nearly as broad as long, with a large median lobe behind, and no other posterior processes.



## THE TREE IN WINTER.

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When autumn has turned the verdancy of the forest into discolored hues, and the roaring gales have shaken off the last withered leaf,

“And woods, fields, gardens, orchards, all around  
The desolated prospect thrills the soul,”

even then nature is not dead, she sleeps only. The new life lies hidden in the bud, born early in summer from the axil of the leaf.

It is our own fault, if in the bare forest we see only a crowd of wooden trunks and limbs and twigs. There is in winter an abundance of objects to be studied by the naturalist. The book of nature lies open at every season to the attentive eye.

To recognize the different trees in winter is not only amusing to the friend of nature, but in many cases of great practical use. To expose the characters by which the species of our woody plants can be distinguished in winter, is the aim of this paper. As the space allowed is not sufficient for a synoptical description of each single species,—matter enough to fill a book,—the reader cannot expect more, in these few lines, than an introduction to the subject, and may accept this as an invitation to inform himself by autopsy and study, assisted by the most necessary drawings.

Everybody will easily recognize, even at a distance, an old oak tree by its stout stem, its strong crooked divaricate limbs; or an elm by its dome-like appearance, caused by its numerous twigs dividing from a number of primary limbs of equal strength; or a *Gymnocladus* by its slender stem with but few branches and comparatively thick twigs. In some trees the bark is characteristic: that of the hackberry is very rough with narrow elevated ridges, while that of the beech and hornbeam is quite even and smooth. The bark of the shell-bark hickory separates the outer layers in long flaps, while in the mockernut and bitternut it is compact, and often nearly smooth; sometimes the bark of the stem is rough and that of the limbs smooth, as in the red oak; the bark of the twigs is often corky-ridged (*Quercus macrocarpa*), or separates in small flaps (*Quercus bicolor*), or bears two opposite corky ridges (*Ulmus alata*). In many trees the ridges anastomose obliquely, leaving lozenge-shaped spaces. The white color of the bark of the canoe birch is very characteristic. The whole division of white oaks differs from that of the black oaks by the color of the bark, which is paler in the former and darker in the latter. We have no surer guide than the characters taken from the arrangement, form and construction of the buds and, in many cases, the form of the leaf-scars.



## PHYLLOTAXIS.

As the buds grow from the axils of the leaves, their arrangement is the same as that of the leaves. They are either opposite or alternate.

When the buds are opposite, one pair stands transversely to the next lower, so that, when seen from above, the four buds form a cross, as do also the leaves and the branchlets; the third pair corresponds to the first one. This position is called decussate, and we find it in the species of *Euonymus*, *Staphylea*, *Aesculus*, *Acer*, *Negundo*; *Hydrangea*, *Cornus* (except *C. alternifolia*), *Lonicera*, *Sambucus*, *Viburnum*, *Bignonia*, *Tecoma*, *Fraxinus*, *Foresteria*.

A whorl of three buds we find in *Catalpa*, and also usually in *Cephalanthus* (sometimes four or only two). Each whorl alternates with the next one, so that, seen from above, a whorl of six is formed. In all the rest of our woody plants the buds are alternate. Though seemingly irregular they are arranged in a definite order. The buds are alternate in two lines (bifarious), or in other words the third bud corresponds to the first, the second to the fourth; two buds make one circuit, and this is expressed by the fraction  $\frac{1}{2}$ ; the numerator indicates the circuit, the denominator the number of buds. This arrangement we find in the species of *Asimina*, *Vitis*, *Ampelopsis*, *Cereis*, *Hamamelis*, *Brunnicia*, *Dicca*, *Ulmus*, *Celtis*, *Morus* and *Smilax*.

In *Betula* and *Alnus* three buds make one circuit in a spiral line; the fourth bud stands above the first ( $\frac{1}{3}$ ).

In the majority of our woody plants five buds make two turns in a spiral line, and the sixth bud stands above the first (two-fifths). In the oaks the upper buds are somewhat crowded. The beech and *Tilia*, though properly belonging here, have the buds on the horizontal branches in two opposite lines.

There is one little tree (*Ptelea*) with eight buds in three circuits ( $\frac{2}{3}$ ), and one shrub (*Amorpha fruticosa*), with thirteen buds in five circuits (five-thirteenths). In *Rhamnus* four buds make one circuit, but the merithalls\* between the first and second and the third and fourth, are much shorter than between the second and third; and as we sometimes find the pairs of buds in *Euonymus* and *Fraxinus* displaced (one higher than the other), we may conclude that *Rhamnus* belongs to the same division as those. The position is properly decussate. The same conclusion we may make in regard to the elm, the seedling of which has opposite leaves; and perhaps we may explain the bifarious position of the buds on the branches by a (hypothetic) torsion of the merithalls.

The best way to count the buds and their circuits, is to thrust a pin into each leaf-scar at a right angle to the stem, and attaching a thread to it, pass this from the lower to the next higher until the one is reached which corresponds to the first one.

Figures 18—21 on Pl. IV show in diagram the phyllotaxis of four different woody plants. The figures represent the bark split longitudinally

\*Internodes.

and laid flat. The lines represent the vascular bundles, which enter the bud at the numbered points. In Fig. 19 we see that the fibres of two-fifths of the vascular ring enter into one leaf. If we segregate the meristhalls and put the buds at the same level, we have a whorl of 5, 8 and 13, and the whole number of buds represents a whorl pulled out into a spire.

There are sometimes supernumerary buds in some species of *Juglans*, *Carya*, *Gymnocladus*, *Amorpha*, *Gleditschia*; two to even four buds appearing one above the other. The uppermost develops, or it forms an abortive twig, a spine (*Gleditschia*); then the next lower develops, the lowest remaining dormant. In *Crataegus* the axillary bud is often transformed into a spine, when an accessory bud appears on both sides.

The species with opposite buds have a true terminal bud. This is sometimes abortive and wanting in *Euonymus* and *Staphylea*, or the shoot had an indefinite growth and withered in fall at the upper end, as in *Sambucus*, *Tecoma*, *Catalpa*, *Cephalanthus*. Then of course there is no terminal bud.

#### SIZE AND FORM OF THE BUD.

The buds of our woody plants are formed in summer, and are visible during winter. Only *Gleditschia* and *Robinia* show no buds in winter; these are hidden in the bark and break forth only in spring. Others show only a little knob (*Ptelea*, *Cephalanthus*). There are a number of trees which have very large buds, at least at the upper end of the shoot (*Aesculus*, *Fraxinus*, *Juglans*, *Carya*, *Populus*), others very small ones (*Cercis*, *Celastrus*). The buds are either leaf-buds or flower-buds or mixed, containing leaves and flowers at once. The latter are quite similar to the leaf-buds: the flower-buds are mostly more roundish and swollen, and placed at the lower part of the shoot (*Fraxinus*), but some flower-buds are cylindrical and appear (in *Rhus aromatica*) at the upper end of the shoot.

The true terminal bud of the species with decussate buds and the pseudo-terminal bud of the species with alternate buds, are often much larger than the axillary buds; and, as these are often the only ones that produce new shoots, these trees show in winter a limited number of long branches. When we examine such branches, we find sometimes a row of shoots, each with a few approximated leaf-sears, and below these a ring of narrow sears of the bud scales, fixing the limit of each shoot, and then a long shoot with remote buds. (*Fagus*, Fig. 16 on Pl. II, and *Cornus alternifolia* Fig. 9 on Pl. III.) By counting these shoots we can determine the age of the branch.

The bud is fusiform, often very slender (*Amelanchier*, *Cornus*, *Virburnum lentago*); or ovate, more or less pointed (*Aesculus*), or oval and obtuse (*Diospyros*, *Ulmus fulva*), or globular (*Crataegus*), or compressed (*Asimina*, *Liriodendron*, *Hamamelis*).

#### DIRECTION OF THE BUDS.

The axis of the bud stands mostly at an angle of 15 to 45 degrees to

the axis of the branch, sometimes at a right angle (*Fagus*, *Celastrus*); or the bud is appressed, the axis being parallel to the shoot (*Cornus*, *Virburnum*, *Salix*\*).

The axis of a bud which stands straight above the leaf-scar is radial, it points to the centre of the branch; but in some species, particularly in those with bifarious buds (*Morus*, *Celtis*, *Ulmus*, *Tilia*) the bud stands not right above the leaf-scar but a little aside, then the direction of the bud is oblique, and its axis is tangential, it strikes the periphery of the shoot. The axis itself is sometimes not straight, but bent (*Celtis*, *Ulmus*).

#### THE SCALES OF THE BUD.

The number of scales is not always definite. It is said to be ten in *Carya alba*; and yet I have counted in the upper bud a greater number, sometimes even as many as twenty, though in many species the number is constant. *Salix* has the bud covered by a single hood-like scale, *Tilia* has two, the inner one larger and enveloping the bud with overlapping margins. In *Negundo* and *Staphylea* one pair is visible, the inner ones are herbaceous and pass into leaves. *Acer dasycarpum* has four pairs, and *Acer saccharinum* eight pairs, *Aesculus* four opposite rows of five to six scales each. *Fraxinus* and *Euonymus* have three pairs.

The arrangement of the scales follows the rule of Phyllotaxis. In the bifarious species the scales are arranged in two rows, and there are four scales in each row (in *Ulmus*, *Celtis*, *Morus*). In those with five buds in two circuits the buds have the same arrangement, they are imbricate.†

The form of the scales is often variable in the same species and the same individual. It is mostly ovate and convex, pointed (*Aesculus*, *Populus*, *Quercus coccinea*), or mucronate (*Crataegus*), or obtuse (*Corylus*, *Quercus nigra*). The scales are pinnately grooved at the upper end in many species with pinnate leaves (*Fraxinus*, *Juglans*, *Carya amara*).

The surface is smooth (*Crataegus*, *Quercus rubra*), or pubescent (*Fagus*, *Carya alba*), or tomentose (*Rhus glabra*, *Ulmus fulva*, *Quercus coccinea*), or sericeous (*Direa*), or velvety (*Asimina*), or furfuraceous (*Carya amara*). The color is mostly brown, but sometimes green (*Euonymus*), yellow (*Carya amara*, *Direa*, *Liriodendron*), rusty red (*Zanthoxylon*), bluish black (*Fraxinus sambucifolia*), purplish brown (*Asimina*). Some have a darker colored zone along the margin (*Morus*).

#### VERNATION.

When we cut a bud horizontally, we observe the inner arrangement, the position of the leaves and their parts. In the species with decussate

\*In *Salix cordata* Var. *angusta*, only the flower-buds are somewhat spreading.

†M. C. De Candolle (*Memoire sur la famille des Juglandees*) calls the buds of *Carya olivaeformis* and *amara* decussate. That may be true concerning the lateral buds; in the terminal buds, as many as I have examined, I have found the phyllotaxis invariably 2-5.

The same author differs from other botanists in his phyllotaxis, since he passes from one scale, bud or leaf to the next on the longest and not on the shortest line, and thus, of course, makes three circuits instead of two.

buds the pairs stand at right angles, the lower ones outside, those higher on the shoot inside (Pl. I, Figs. 21-25). In the bifarious species the leaves are located side by side, the lowest outside, the highest in the middle, the posterior side of the midrib looking toward the leaf-sear (*Ulmus*, Pl. IV, Fig. 14); or they stand opposite, the lower inclosing the upper ones (*Celtis*, Plate IV, Fig. 15), the posterior side of the midrib looking toward the bud-scales. In those with the spiral position of the buds the leaves are arranged in the same way; the posterior side of the midrib looks toward the corresponding seale (*Populus*, Pl. IV, Fig. 16). When the species has compound leaves, the leaflets lie either side by side or in a half-circle, the uppermost in the middle, the lower ones at the sides (*Carya alba*, Pl. IV, Fig. 17).

The blade of the leaf is either conduplicate (*Prunus*\*, *Amelanchier*, *Asimina*, *Cercis*, *Ulmus*, *Tilia*), or plieate (*Acer*, *Hamamelis*, *Ribes*), or involute (*Euonymus*, *Clastrus*, *Staphylea*, *Populus*, *Viburnum*), or revolute (*Salix*, *Ptelea*) or convolute (the leaflets of *Carya*, Pl. IV, Fig. 17), or equitant (*Cornus*, Pl. I, Fig. 24, or open and slightly concave (*Cephalanthus*, *Sassafras*).

A very singular arrangement we observe in *Liriodendron*, Pl. III, Fig. 4. The leaf is conduplicate and bent inward from the upper part of the petiole, and the cover of the bud is nothing else than the two stipules of an abortive leaf.

#### LEAF-SCARS.

At the base of the bud we observe the sear of the fallen leaf, an area of varying form, covered with a thin layer of corky matter which is formed in the latter part of the season and separates the leaf from the shoot; and within this area we notice the vestiges of the vascular bundles that enter the leaf-stalks.

The sears are either flat upon the stem (*Aesculus*), or on a projection, pulvinate (*Quercus*); they are sometimes concave (*Ampelopsis*, *Catalpa*), or convex (*Ulmus*).

The form of the sear depends on the form of the base of the leaf-stalk, and is very variable. It is narrow, nearly linear (*Negundo*), or ersecent-shaped (*Cornus*, *Viburnum*), or triangular (*Populus*), or semi-circular (*Fraxinus*, *Quercus*), or elliptical (*Liriodendron*), or three-lobed (*Crataegus*, *Cercis*, *Amorpha*), with five sharp angles (*Lonicera flava*), or oval with the upper end truncate or emarginate (*Tecoma*, *Catalpa*, *Sassafras*), or heart-shaped (*Rhus toxicodendron*, *Gleditschia*, *Juglans*, *Carya*), or horse-shoe shaped (*Rhus glabra*, *Ptelea*), or ring-shaped around the bud (*Platanus*, *Direa*). Here the bud was covered by the hood shaped basis of the leaf-stalk. In *Direa* the bud is situated in a cup-like cavity the margin of which forms the leaf sear. When two sears of opposite leaves meet (*Negundo*), the twig seems to be articulated.

The marks of the vascular bundles are very characteristic, presenting sometimes one point in the center (*Celtis*), or a horizontal streak (*Sassafras*).

\*The European species of *Prunus* proper have convolute leaves.



Usually there are three points forming a triangle, or more and then forming either a curved line (*Asimina*), a horseshoe-shaped line (*Cephalanthus*), or a closed chain following the outline of the sear (*Morus*, *Sambucus*, *Fraxinus*), or separating in groups (*Juglans*, *Carya*, *Gymnocladus*). The marks are somewhat concave (*Aesculus*) or convex (*Lindera*).

#### THE TWIGS.

The direction of the twig commonly agrees with the direction of the bud. The *Sassafras* has a peculiar growth; the secondary shoots of the summer from the lower buds attain a greater length than the primary ones, and as the shoots are curved upward, the whole has the appearance of a chandelier (Pl. III, Fig 7). The shoots are either smooth (*Fraxinus americana* and *sambucifolia*, *Acer*, *Crataegus*), or pubescent (*Fagus*, *Betula*), or rough hairy (*Corylus*, *Ulmus fulva*), or tomentose-pubescent (*Fraxinus pubescens*, *Carya olivaeformis*, *Diospyros*), or prickly, and then the prickles are placed irregularly on the bark (*Rosa*, *Rubus*, *Smilax*), or there is only one on each side of the sear, representing a stipule (*Robinia*, *Zanthoxylon*). Prickles should not be confounded with spines (or thorns). *Ribes* has a spine below the persistent base of the leaf-stalk, and this represents a bract.

In many species we see ridges running downward from the leaf-sears (*Populus monilifera*, *Rhus toxicodendron*), in some species with opposite leaves these ridges are very sharp and prominent, and the twig becomes quadrangular (*Fraxinus quadrangulata*, *Euonymus atropurpureus*).

The color of the twig is mostly brown, but other colors occur, red (*Cornus sericea*), purplish (*Cornus alternifolia*, *Asimina*) yellowish (*Platanus*), green (*Sassafras*, *Euonymus*, *Staphylea*, *Negundo*), grayish (*Fraxinus sambucifolia*, *Rhamnus*), white, thickly covered with a white woolly pubescence (*Salix candida*).

#### THE PITH.

The pith in a horizontal section of a twig shows different forms in the different species, and in the same individual. In the middle of the merithall (space between two single leaves or pairs of leaves or whorls), it is more or less circular in the majority of our species: but sometimes it shows a hexagonal shape in species with opposite leaves; in those with five leaves in two circuits, a pentagon (*Sassafras*, *Liquidambar*), or a five-rayed star (*Quercus*, *Populus*). Near the upper end of the merithall (wrongly called "joint,") the form of the pith is modified by projections towards the leaf or pair of leaves.

The vertical section in *Juglans* and *Celtis* shows the pith in horizontal plates. I have observed this only in one other plant of our flora, the *Phytolacca*.

The color of the pith is mostly whitish, pure white in *Sassafras*, often with a rosy tinge in *Tilia* (cream color when older), yellowish in *Rhus glabra* and *Rhus toxicodendron*, reddish in *Gymnocladus*, *Cornus*, *Rhus aromatica*, greenish in *Gleditschia*, brownish in *Juglans cinerea*, *Carya amara*.

It is very large in proportion to the thickness of the wood in *Sambucus*, *Sassafras*, *Rhus*. Only *Smilax* has no pith: it belongs to the endogenous plants.

To treat of the wood here, would lead us too far, for the matter is too ample to be condensed into a small space.

The plates will aid somewhat in the identification of specimens.

## SODIC PINATE AS A TEST FOR LIME.

By J. A. SEWALL.

Pinic acid or sodic pinate precipitate salts of calcium, magnesium and iron.

I have recently made some experiments with the sodic pinate, with reference to its delicacy as a test for detecting the presence of the salts of the first mentioned metal (calcium), with the following results, using a solution of calcic sulphate:

$\frac{1}{2500}$  part of calcic sulphate in one part of water, yields a very copious amorphous precipitate, which readily subsides.

$\frac{1}{3000}$  part yields an abundant bulky precipitate.

$\frac{1}{10000}$  part, an abundant precipitate.

$\frac{1}{25000}$  part, an immediate cloudiness, and in a few minutes a good precipitate.

$\frac{1}{50000}$  part, quite the same result as is given by the  $\frac{1}{25000}$  solution.

$\frac{1}{125000}$  part, a very satisfactory deposit after a little time.

$\frac{1}{250000}$  part, a distinct turbidity, and after a few hours a satisfactory deposit.

I observe that on adding a few drops of the reagent to distilled water, the solution becomes, after several days, slightly opalescent.

The reagent was prepared by dissolving one part of the sodic pinate in fifteen parts of distilled water and filtering the solution.

The quantity of the solution of the calcic sulphate operated on in each trial was one fluid ounce. The quantity of the sodic pinate solution used in each trial varied from two to ten drops, the larger quantity being used in the stronger solution of the calcic salt.

Ammonic oxalate fails to precipitate lime in a  $\frac{1}{63000}$  solution, (*Fredericus*).

It will be seen from the above that the sodic pinate is a much more delicate test for calcic salts than the ammonic oxalate. The deportment of other calcic salts is quite the same as that of the sulphate.

# A PARTIAL CATALOGUE OF THE FISHES OF ILLINOIS.

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By E. W. NELSON.

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Owing to the slight attention the ichthyology of the region herein treated has received, the present catalogue must necessarily be very incomplete.

With the exception of Mr. R. Kennicott's list of fishes of Cook county, (Ill. Agl. Report) in which only thirty species are mentioned, and occasional descriptions of new species or the mention of the receipt of specimens from within our limits in the papers of various writers, nothing has been definitely known regarding the ichthyic fauna of the state. During the last three or four years, considerable collections of fishes have been made in various parts of the state, under the auspices of the Illinois Museum of Natural History.

The present paper is based mainly upon this material, which, through the generosity of the management of the above-named institution, I have been enabled to study. I am also greatly indebted to Prof. S. A. Forbes, Curator of the Museum, for notes upon the distribution and peculiarities of structure in many of the species. To Dr. D. S. Jordan, of Irvington, Indiana, I am under obligations for the loan of specimens, for invaluable aid in verifying doubtful identifications, and for notes on the distribution of many of the species, especially in the Wabash valley.

The collections in the Museum have been made principally by Prof. Forbes, in the following localities: Illinois river from La Salle to Pekin; the Vermilion river in La Salle county; Mackinaw creek in McLean county; Rock river at Oregon; Pecatonica river at Freeport; the Ohio and Mississippi rivers at Cairo; the outlet of Big Lake, in Jackson county; Callahan and Drury creeks, in Union county; Lake Michigan at Chicago, and some of the smaller tributaries of the above-named streams. In addition to these, small collections have been made by myself, from the Calumet river and its tributaries, in Cook county; Lake Michigan, at Chicago; small tributaries of the lake at Waukegan, and the Fox river at Geneva. Where species are included upon the authority of others, due credit is given. As will be seen by the list of localities, the streams from which collections have been made are nearly all tributaries, directly or through the Illinois, to the Mississippi, thus leaving the Wabash and Ohio with their tributaries comparatively unexplored, except portions of the Wabash valley, where collections have been made for Prof. Jordan; and so little work

has been done in the entire southern third of the state, that but slight idea can be formed of the exact distribution or of the number of species which exist there. The synonyms mentioned are only intended to connect the names here given with those used in Prof. Jordan's Manual of the Vertebrate Animals of the Northern United States.

FAMILY PERCIDAE.

*Genus Micropereca, Putnam.*

1. *M. punctulata*, Putnam. Least Darter. Not uncommon in Fox river, at Geneva, and in clear tributaries to Lake Michigan at Waukegan. Not common in the Wabash valley.

2. *P. flabellatus*, (Raf.) Cope. Fan-tailed Darter. Common in clear brooks in Wabash valley.

3. *P. lineolatus*, (Ag.) Jord. Striped Darter. Found in clear streams in Northern Illinois, where it replaces the preceding.

4. *P. niger*, (Raf.) Jord. Trout Darter. Very rare in the Wabash valley.

*Genus Poecilichthys, Ag.\**

5. *P. caeruleus*, (Stor.) Ag. Blue Darter. Common through Southern Illinois, and especially abundant in the Wabash valley.

6. *P. spectabilis*, Ag. Striped Blue Darter. Not so generally distributed as the preceding; is confined to the northern part of the state. In distribution this and the preceding species bear the same relations as *P. lineolatus* and *flabellatus*.

*Genus Bolcichthys, Grd.*

7. *B. exilis*, Grd. Red-sided Darters. The only specimens I have seen from the state were taken in a clear brook flowing into Lake Michigan at Waukegan, where it was rather common.

8. *B. eos*, Jordan, Mss. Common in small clear streams in Northern Illinois and Southern Wisconsin.

For the following synopsis of the species of this genus I am indebted to Prof. Jordan: The characters ascribed to *B. fusiformis*, *B. erochrous* and *B. barratti* are from Cope (Proc. Phil. A. N. S., 1864, 233); those of *B. warreni* from Girard (Proc. Phil., A. N. S., 1859, 104).

\*Lateral line distinct about to middle of first dorsal, on about 12 scales: 52 transverse rows: head  $3\frac{1}{4}$  in length; D. VIII—9. Mass. *fusiformis* (Grd.)

\*\* Lateral line distinct to middle of first dorsal, on 12 to 18 scales; head 4 in length. D. IX or X—10.

†Scales in 42 to 44 transverse rows; eye as long as snout, 5 in head; sides with dark band and reddish punctulations. New Jersey.

*erochrous* (Cope)  
††Scales in 45 to 50 transverse rows; eye 3 to  $3\frac{1}{2}$  in head, longer than snout; sides with a row of round crimson spots (in life); form slender. Illinois to Montana.  
*exilis* (Grd.)

\* Includes *Catnotus*, *Notonotus* and *Poecilichthys*. Jord. Man. Vert.



\*\*\*Lateral line on 20 to 30 scales.

† Head  $3\frac{2}{3}$  in length: lateral line not to end of first dorsal: scales smallest, 60 in lat. l.; D. IX or X—9 or 10. Body fusiform, elongated, caudal peduncle notably much elongated; size large, life coloration brilliant. Northern Illinois and Wisconsin, *ecos* (Jordan), *Miss.*

†† Head  $3\frac{1}{3}$  in length; lateral line variously incomplete: scales rather large, in 45 to 50 transverse series, D. IX or X—12 to 14: caudal peduncle not elongate; body very short and chubby; size small; colors dull. Georgia to Texas. *elegans* (Grd.)

††† Head 4 in length; lateral line extends to origin of second dorsal; 56 transverse series of scales; D. X or XI—10 or 11. South Carolina.

*barratti* (Holbr.)

\*\*\*\* Lateral line unknown; body compact; head shorter than in *B. exilis*; scales smaller; first dorsal with a band of vertically elongated black spots; D. IX—11, A. II, 9. Cannon Ball R. *warreni* (Grd.)

Genus *Pleurolepis*, Ag.

9. *P. pellucidis*, Ag. Sand Darter. Found sparingly in clear sandy tributaries of the Wabash and Ohio. (Jordan.)

Genus *Bolcosoma*, DeK.

10. *B. olmstedii*, (Stor.) Ag. Tessellated Darter. Specimens are in the collection from various localities, and Prof. Forbes informs me that he has found it common in all clear streams. Some specimens from Fox River in Wisconsin show characters exactly intermediate between this and the *atromaculata* of Girard. Other specimens from the Fox River at Geneva, Ill., agree with the description of *atromaculata*, and others from the same locality answer perfectly to *olmstedii*.

11. *B. brevipingue*, Cope. Slim Darter. Apparently everywhere common in clear streams throughout the state.

Genus *Etheostoma*, Raf.

12. *E. blennioides*, Kirt. Black-sided Darter. Rather common in the Wabash valley.

13. *E. phoscocephalum*, sp. nov. This species replaces the preceding in the western part of the state, and from the number of specimens in the collection and the localities represented, appears to be rather common in the Illinois and its tributaries.

*Sp. Char.* Head about 4 times in total length: depth  $6\frac{1}{2}$ ; eye=snout,  $4\frac{1}{2}$  in head: D. XIII—12. A. II, 8. Lat. l. 76. Inter-orbital space more than 6 in head. Cheeks naked: opercles scaly: breast naked. Middle line of belly with line of larger scales or a naked strip. Pectorals shorter than head. Fins mottled; sides with a lateral band of small squarish spots usually connected by a narrow black line. A black spot at base of caudal and one at base of lateral line.

Back mottled and tessellated with dark on a light ground. A black line from eye forward and another downward. This species bears a superficial likeness to *E. blennioides*, but may be distinguished at once by the

shape of the spots on the sides, by the much more slender form and very narrow, pointed, eel-like head, the depth of which is less than half its length, and its width two-fifths its length.

14. *E. evides*. *Jord., Mss.* Barred Darter. Rare Occurs in the lower Wabash and Ohio valleys. (*Jordan.*)

*Genus Percina, Hald.*

15. *P. caprodes* (*Raf.*), *Grd.* Log Perch. A few specimens from the Calumet and Vermilion rivers. Becomes quite numerous in the Wabash valley.

*Genus Perca, Linn.*

16. *P. flavesceus*, (*Mit.*) *Cuv.* Common Perch. Very abundant in Lake Michigan and its tributaries; also occurs, but in smaller numbers, in the Illinois and tributaries. Rare in the Ohio (*Jordan*). Specimens from the clear waters of Lake Michigan are usually a light color—almost white. Often the dark bars, generally so characteristic of the species, are so obsolete that the fish appears to be a clear, yellowish white, with the faintest trace of dark mottling, and the lake perch are rarely as decidedly barred as specimens taken in streams. The river perch may be at once distinguished by the heavy dark bars, and the dark greenish yellow color on the sides. So different are the two that I have several times heard persons speak of them as distinct species.

The aversion of the river form to the lake water and *vice versa*, I have often seen strikingly illustrated. The river bed of the Calumet is so slightly above the lake that during a hard north or northeast storm the lake water gradually forces back the water in the river,—often for a number of miles—and, as the cold lake water fills the channel, the river perch retreat, and their places are supplied by the lake form. As the storm subsides the current of the river forces the lake water back, driving before it the lake perch, and the river perch are again found in their usual haunts.

*Genus Stizostedion, Raf.*

17. *S. americanum*, (*Val.*) *Gill.* Pike Perch. Very common in Lake Michigan and the larger streams throughout the state.

18. *S. griseum*, (*DeK.*) *Milner.* Gray Pike Perch. Very abundant in the larger streams. Whether it occurs in Lake Michigan or not I am uncertain.

19. *S. salmoneum*, (*Raf.*). Salmon Perch. Ohio river and large tributaries. (*Jordan.*)

*Genus Roccus, Mitch.*

20. *R. chrysops*, (*Raf.*) *Gill.* White Bass. Exceedingly abundant in Lake Michigan. Common throughout the state.

*Genus Morone, Mitch.*

21. *M. interrupta*, *Gill.* Short-striped Bass. A number of specimens in the collection from Mackinaw creek and the Illinois river.

*Genus Micropterus, Lae.*

22. *M. nigricans*, (*Cuv.*) *Gill.* Large-mouthed Black Bass. Found in

great abundance throughout the state, as far as I can learn. The young are found in myriads in the ditches draining the marshes along the Calumet river.

23. *M. salmoides*, (Lac.) Gill. Small-mouthed Black Bass. Like the preceding, found in all parts of the state, and in nearly equal numbers.

*Genus Centrarchus, Cuv.*

24. *C. irideus*, (Bosc.) C. & V. Shining Bass. A single specimen, about three inches in length, is in the collection from a small stream flowing into the Mississippi, near Fountain Bluff, Southern Illinois.

*Genus Pomoxys, Raf.*

25. *P. hexacanthus*, (C. & V.) Ag. Calico Bass. Very abundant in the streams and small lakes in Northern Illinois, where it almost, if not entirely, replaces the following. Much less numerous farther south.

26. *P. annularis*, Raf. Croppie. Very abundant in all the streams through Central and Southern Illinois.

*Genus Ambloplites, Raf.*

27. *A. rupestris*, (Raf.) Gill. Rock Bass. Very abundant everywhere collections have been made.

*Genus Chaenobryttus, Gill. (=Glossopolites, Jord.)*

28. *C. gilousus*, (C. & V.) Cope. (= *G. melanops*, (Gir.) Jord.) Black Sun Fish. Prof. Forbes has found this species very common in the Illinois and tributaries through Central Illinois. Specimens have also been taken in Lake Michigan by Prof. Jordan.

*Genus Telipomis, Raf. (=Chaenobryttus, Grd.)*

29. *T. cyanellus*, Raf. Blue Sun Fish. Very abundant throughout the state in both large and small streams.

30. *T. microps*, (Grd.) Nelson. Common in the Calumet river in northeastern, and tributaries of the Illinois in central and western parts of the state.

31. *T. nephelus*, (Cope) Nelson. Occurs rather uncommonly in the Wabash valley; very hardy and voracious. (Jordan.)

*Genus Ichthelis, Raf.*

32. *I. incisor*, (C. & V.) Holbr. Blue Sun Fish. Abundant in all waters throughout the state.

33. *I. speciosus*, (Grd.) Jord. Rather common in the western part of the state in tributaries of the Illinois and Mississippi. Also a few specimens are in the collection of the author from the Calumet river. Although this species approaches closely to *incisor*, yet certain tangible distinctions, sufficient to distinguish the two at sight, are always present as far as my observations have extended.

34. *I. aqualiensis*, (Grd.) Nelson. A fine adult specimen is in the state collection from the Illinois, and a second less mature from the Fox river at Geneva is in my collection.

The following description is made from the adult specimen, seven inches long. Head, with flap,  $2\frac{2}{3}$  in length; depth 2 1-6. Eye=snout,  $4\frac{1}{2}$  in head. The eye is large but smaller than the opercular spot, and not quite equal to inter-orbital space. D. I, 12; A. III, 10; dorsal spines rather short and stout, as long as from snout to middle of orbit. Second anal spine stout, third as long as dorsal spines. Pectorals and ventrals long, about reaching anal, the ventrals being the longer. Ventral spine longer than dorsal spines. Body elongated, much elevated in front, heavy. General form and proportions of *I. obscurus*, (Ag.) Jord. Mouth wide for *Ichthelis*; maxillaries reaching to line from middle of orbit; fins high, spines rather low but very stout. Occipital region very prominent and narrow in adult. The caudal peduncle about as long as wide in front. Color in alcohol, dusky, mottled with orange and blue; cheeks with wide blue bands obscurely defined; dusky dorsal and anal spot. Belly and lower fins with orange and yellow shades, in life apparently coppery yellow; each scale on sides and back with a blackish, longitudinal oblong spot resembling the markings of *I. inscriptus*. Lower jaw and lower parts of cheeks a dull leaden blue, probably brilliant in life: blue line in front of and yellowish band around eye; opercular spot large, flap very broad and black, with a very broad pale edge entirely surrounding the black; the posterior width of edge more than half that of pupil; scales very large and crowded. Lat. l. 46; longitudinal rows 5-14; the lateral line very high; opercular scales large, those on cheeks moderate and six-rowed. Top of head flat and short, forming an angle with abruptly descending profile; rim of orbit slightly elevated. Coloration resembling that of *I. obscurus* and *Pomotis auritus*. Its nearest relative is the former, from which it differs in the presence of blue lines on the cheeks, wider snout and widely margined opercular flap. The smaller specimen bears considerable resemblance to *P. auritus*, being less gibbous and having the opercular flap smaller: it may be distinguished at once, however, by the large mouth and pointed pharyngeals.

35. *I. macrochira*, Raf. Gilded Sun Fish. A few specimens have been examined from tributaries of the Illinois and the Wabash valley.

36. *I. anagallinus*, (Cope.) Bliss. Red-spotted Sun Fish. One specimen in the collection from the Fox river.

*I. inscriptus* probably occurs in the southern part of the state, but I have seen no specimen.

37. *I. megalotis*, Raf. Long-eared Sun Fish. Rather common in the southern part of the state.

38. *I. sanguinolentis*, (Ag.) Bliss. Blue and Orange Sun Fish. Very abundant through the state, especially in northern part.

#### *Genus Pomotis*, Raf.

39. *P. auritus* (L.) Gunth. Common Sun Fish. Very abundant in the northern part of the state. Prof. Jordan informs me that it does not occur in the Wabash valley.

#### FAMILY APHREDODERIDAE.

In the present article I have the pleasure of adding a second genus to



this unique family : and, in consequence of certain characters present in the newly discovered form, the family characters of this group must now read as follows :

Fam. Char. Vent jugular or thoracic, either in front of or between the ventrals. Dorsal fin single, with three or four spines. Ventrals thoracic, without spines and with more than five soft rays. Some bones of head spinous ; teeth on jaws and palate : scales ctenoid : branchiostegals six : coecal appendages about twelve : air bladder simple.

The following table shows the characters of the two genera of this family as they now stand :

*Aphredoderus.*

Vent jugular, in advance of ventral fins. Dorsal nearly equidistant between snout and caudal. Last anal spine short and rather slender.

*Sternotremia, Gen. Nov.*

Vent thoracic, between bases of ventral fins. Dorsal nearer snout than base of caudal. Last anal spine long and slender.

Below is a comparison of the specific characters of the two forms. I may here express my thanks to Mr. F. W. Putnam for the specimen of *A. sayanus* from which the following description is made :

*A. sayanus*, (Gilliams) DeK. Habitat, brooks near the coast from New York to Louisiana.

Vent nearer lower jaw than to ventrals, and less than twice the diameter of the eye from the junction of the gill membranes. Pectorals 1 3-5 in head. Ventrals the same. Longest dorsal ray the same. Longest dorsal spine  $2\frac{1}{2}$  in head. Longest anal ray,  $1\frac{3}{4}$ . Longest anal spine,  $2\frac{3}{4}$ . Caudal fin, 1 1-5. Diameter of caudal peduncle twice in head. Ventrals well separated, slightly decurrent. Vent opposite middle of opercle.

Longest anal spine less than from snout to middle of orbit. Scales considerably larger anteriorly, larger on opercle than on cheek. Lower posterior angle of cheeks about a right angle. Eye=snout, and also inter-orbital space. Ventrals considerably in front of dorsals. Distance from snout to anterior ray of dorsal  $2\frac{1}{2}$  times base of dorsal. Scales on cheeks and opercles large and loose.

*S. isolepis, sp. nov.* Habitat, small, weedy tributary to the Calumet river near Chicago, and small streams in South Illinois.

Vent more than twice as far from lower jaw as from ventrals ; also more than three times the diameter of the eye from the junction of the gill membranes.

Pectorals, 1 3-5 in head. Ventrals  $1\frac{3}{4}$ . Longest dorsal ray,  $1\frac{2}{3}$ . Longest dorsal spine,  $2\frac{1}{4}$ . Longest anal ray,  $1\frac{3}{4}$ . Longest anal spine 2, and as long as from snout to posterior border of orbit. Caudal fin  $1\frac{1}{4}$  in head. Each scale with an edge of dark punctations, forming fine longitudinal streaks or lines. Vent behind end of opercle, and between bases of ventrals.

Diameter of caudal peduncle  $1\frac{3}{4}$  in head.

Scales on body nearly equal, being, if anything, a trifle larger on the caudal peduncle. Scales on opercle slightly larger than on cheeks, the latter being scattered and imbedded. Angle of cheeks rounded and more than a right angle.

The distance from snout to anterior ray of dorsal less than twice the base of dorsal. Eye  $1\frac{1}{2}$  times in inter-orbital space, and more than once in snout.

Color of living specimen a clear greenish olive, lighter below ; becoming yellowish or orange on abdomen.

Branchiostegals, 6.  
 Head in length,  $2\frac{3}{4}$ .  
 Depth, 3 1-10.  
 Eye in head, 4.  
 Dorsal IV, 10.  
 Anal, III, 6.  
 Ventrals, 7.  
 Pectorals, 10.  
 Lat. l., 44.  
 Longitudinal rows, 8-10.  
 The specimen of *Aphredodereus* measures 3 inches.

Branchiostegals, 6.  
 Head in length, 3.  
 Depth, 3 1-10.  
 Eye in head,  $4\frac{2}{3}$ .  
 Dorsal, III, 11.  
 Anal, III, 6.  
 Ventrals, 7.  
 Pectoral, 10.  
 Lat. l., 48.  
 Longitudinal rows, 10-11.  
 The largest specimen of *Sternotremia* from the dozen or more examined, is  $2\frac{1}{2}$  inches; the average is about 2 inches.

#### FAMILY SCIAENIDAE.

##### *Genus Haploidonotus, Raf.*

40. *H. grummiens*, Raf. Sheepshead. Common in Lake Michigan and all the larger rivers.

#### FAMILY COTTIDAE.

##### *Genus Cottopsis, Grd.*

41. *C. ricei*, sp. nov.. Rice's Cottus. Through my friend Mr. F. L. Rice, of Evanston, I am enabled to make the present interesting addition to the lake fauna. The only specimen seen is the type, which was picked up on the shore of Lake Michigan near Evanston, and placed in my hands for identification by Mr. Rice.

Description: Head, 3 3-5; depth, 5 1-3; eye  $4\frac{1}{2}$ ,  $1\frac{1}{2}$  in inter-orbital space and equals snout; first dorsal 8, second dorsal and anal destroyed. Ventral 1, 4; pectoral 15; palatine teeth present; body short and stout, head much depressed; back almost terete. Body abruptly contracted opposite base of anal; tail very small, sub-terete. Outline tadpole-like. Jaws about equal; mouth rather narrow; jaws contracted and somewhat produced; head very broad and flat, broader than body, breadth greater than length; depth half length. Eyes on upper surface, near together. Preopercular spine extremely large; three times as large as in any other fresh water cottoid known: as long as eye; hooked backward and upward, giving a buffalo-like appearance. Three spines hooked downward below the large spine; the lower concealed. A strong spine hooked forward at base of opercles. Branchiostegals 6. Isthmus as wide as from snout to middle of orbit. Base of pectorals crescentic, their tips just short of anal. Rays all simple. Ventrals under pectorals, decurrent.

Ventrals reaching  $\frac{2}{3}$  of the distance to vent. Profile rising rapidly to dorsal, which runs along a sort of carina. Dorsal beginning a trifle behind ventrals, just behind the head, about midway between snout and anal. Vent midway between snout and base of caudal.

Depth at first ray of anal less than half length of head; thickens at same point over  $\frac{1}{5}$ .

Least depth  $\frac{1}{4}$  of head. Caudal peduncle extremely slender and sub-terete, suggesting a stickleback. Head smooth. Space above lateral line

behind head covered with small stiff prickles hooked backwards, readily visible as small black specks when skin is dry.

Length, 2 5-6. Color pale brown, irregularly spotted and mottled with darker brown, somewhat as in *Lota*. Pectorals mottled: belly white; spines spirally curved, forming half a spiral. The most peculiar characters are the strong spines of the preopercle and the smaller ones below, the carinated back and abruptly contracted body, forming the sub-terete caudal peduncle. The prickles of the skin seem to be more developed than in the other described species.

*Genus Uranidea, DeK.*

*U. hoyi*, (Put.) Mss. Hoy's Bull-Head. For the privilege of including this and the following species and descriptions I am indebted to the kindness of Dr. P. R. Hoy of Racine, Wisconsin:

Description of an adult female taken twelve miles off Racine in forty-two fathoms of water, June 4, 1875, from a very accurate drawing by Mr. A. L. Kumlien: D. VI, 15: A. 11: V. I, 3; P. 13; C. 12: length 2 1-6 in, head  $3\frac{1}{4}$ : depth  $4\frac{1}{4}$ . Width of head equals its length. Eye  $3\frac{1}{2}$ : body short, stout, broad and thick in front, very abruptly compressed behind. Fins all low. P. with lower rays rapidly shortening, reaching just to anal and beyond second dorsal. First dorsal low and small,  $\frac{2}{3}$  as long as soft part and connected by membrane at base. Lower jaw unusually projecting.

43. *U. kumlieni*, (Hoy) Mss. Kumlien's Bull Head. Deep water in Lake Michigan.

D. VI, 17: A. 12: P. 14: V. I, 3: head  $3\frac{1}{2}$ : depth 6. Body slender as in *boleoides*. Head large and long, its width a little over half its length, depth a little less.

Eye large, equal to snout and  $3\frac{1}{2}$  in head, more than two times in inter-orbital space. Pectoral base crescentic, the fin as long as head: the lower rays rapidly shortening, reaching second or third dorsal ray and falling just short of anal: fourth and fifth rays largest. No palatine teeth. Preopercular spine not much hooked, directed upwards and backwards. Vent midway between front of eye and base of caudal. Mouth wide, oblique: maxillary to middle of eye. Lower jaw projecting. First dorsal high, 5-6 second. Second spine longest, almost filamentous; membrane connecting the dorsals. Caudal peduncle long and slender. Caudal narrow,  $\frac{2}{3}$  head. Lat. l. disappears under middle of second dorsal. Dorsal and anal high, their rays projecting. Length three inches. The above description is from one of Dr. Hoy's types.

*Genus Pegedichthys, Raf.*

44. *P. alvordi*, Grd. Common in the Rock river and probably in other streams.

*Genus Trigloopsis, Grd.*

45. *T. thompsoni*, Grd. Deep-water Sculpin. Deep water in Lake Michigan.

## FAMILY GADIDAE.

*Genus Lota, Cuv.*

46. *L. lucustris*, (Mitch.) Gill. Eel-pout. Very abundant in Lake Michigan; rare in the Ohio (Jordan), and in the Illinois (Forbes).

## FAMILY GASTEROSTEIDAE.

*Genus Eucalia, Jord.*

47. *E. inconstans*, (Kirt.) Jordan. Stickleback. Has been found rather common in small tributaries to Lake Michigan, and in Rock river, by Prof Jordan.

48. *E. pygmaea*, (Ag.) Jord. Oeours in Lake Michigan. (Jordan.)

*Genus Pygosteus, Brer.*

49. *P. nebulosus*, (Ag.) Jord. Many-spined Stickleback. Lake Michigan. (Jordan.)

## FAMILY ATHERINIDAE.

*Genus Labidesthes, Cope.*

50. *L. sicculus*, Cope. Silverside. This beautiful little species exists in the greatest abundance in the rivers and small streams tributary to the Illinois, in the western and central parts of the state. As far as I have learned, it does not occur in Lake Michigan or its tributaries. Neither does it occur in Rock river. Its centre of abundance seems to be the streams in the more strictly prairie region of the state.

## FAMILY CYPRINODONTIDAE.

*Genus Fundulus, Lac.*

51. *F. diaphanus*, (LeS.) Ag. Barred Minnow. Very abundant about the sandy mouths of tributaries to Lake Michigan, keeping in "schools" in the shallow water near the edge. Oeours in smaller numbers throughout the state, specimens having been taken in nearly all the large streams.

*Genus Zygonectes, Ag.*

52. *Z. notatus*, (Raf.) Jord. (= *Z. olivaceus*, Stor.) Top Minnow. Common in the Illinois and smaller tributaries, and in most streams through the state, except in the tributaries of Lake Michigan.

53. *Z. dispar*, Ag. Striped Minnow. A number of specimens are in the state collection from the Illinois river at Pekin, and others from several small tributaries. The following is the description of an average specimen from the Illinois river at Pekin:

Adult about  $1\frac{1}{2}$  inches long. Head in length  $3\frac{2}{3}$ ; dorsal 7. Depth in length  $4\frac{1}{3}$ ; anal 9. Lateral line 32 to 34; longitudinal rows 9. Eye longer than snout, 3 in head. Dorsal commencing slightly behind anal; back flattened and plane with the top of the head, sloping from the dorsal to the end of the snout. Caudal peduncle broad, width  $\frac{1}{2}$  head. Colors (in alcohol) above and on sides olive; vertebral line and top of head darker; also a crescentic patch of dark brownish extending downward and obliquely backward from the lower posterior part of orbit. Entire head scaly, scales



on the top larger than those on the body. Sides of the scales on the body with longitudinal brown spots, forming very distinct, but rather narrow, brown, longitudinal lines. Along the center of each scale is a row of very fine brown dots, forming minute lines between the heavier ones along the borders of the scales. Beneath, in front of the anal fin, orange yellow.

FAMILY UMBRIDAE.

*Genus Melanura, Linn.*

54. *M. limi*, (Kirt.) Ag. Mud Minnow. Exceedingly numerous in prairie sloughs and sluggish streams in the northeastern part of the state. It is also of very rare occurrence in the streams through the state tributary to the Ohio, where it is occasionally taken.

FAMILY ESOCIDAE.

*Genus Esox, Linn.*

55. *E. nobilior*, Thomp. Muskellunge. Rather common in Lake Michigan, and reported to occur in some of the small lakes in the northern part of the state.

56. *E. lucius*, var. *stor*, (LeS.) Lake Pike. Very abundant throughout the northern part of the state.

57. ?? *E. boreus*, Ag. Several specimens, about seven inches long, are in the collection of the writer, from the Fox river at Geneva.

58. *E. salmoneus*, Raf. Little Pickerel. Abundant throughout the state.

59. *E. cypho*, Cope. A single specimen, in good condition, from the Fox river at Geneva, agrees in every way with Prof. Cope's description of this species (Proc. A. N. S., Phil., 1865, p. 78), with the exception that the bars and dots are obsolete in my specimen. Although Prof. Cope has referred this to a previously described species, yet so marked are its characteristics, that several who have examined my specimen have at once referred it to this species.

60. *E. umbrosus*, Kirt. Four specimens from the Fox river at Geneva, —Prof. Cope's Var. A. of this species. (Trans. A., Ph. Soc., 1866.) This species approaches closely to *salmoneus*, and may eventually be reduced to a variety of that species.

FAMILY PERCOPSIDAE.

*Genus Percopsis, Ag.*

61. *P. guttatus*, Ag. Trout Perch. Numerous in Lake Michigan, and of rare occurrence in the larger rivers.

FAMILY SALMONIDAE.

*Genus Salmo, Linn.*

62. *S. salar*,\* L. Great Sea Salmon. Fox river at Aurora and near Elgin.

63. *S. quinnat*,\* Rich. California Salmon. Fox river at Aurora and near Elgin.

\* As this paper is passing through the press, I learn from Dr. W. A. Pratt, of Elgin, that he has taken these two species this summer, at the localities given. I therefore take the liberty of inserting them in this list.—S. A. FORBES.

64. *S. namaycush*, Penn. Lake Trout. Abundant in Lake Michigan.

*Genus Arggyrosomus, Ag.*

65. *A. chupeiiformis*, (Mitch.) Ag. Lake Herring. Very abundant in Lake Michigan. The sisco (*A. sisco*, Jord.) undoubtedly occurs in the deep sandy lakes in the northeastern part of the state.

66. *A. nigripinnis*, Gill. Black-fin. Common in deep water in Lake Michigan.

67. *A. hoyi*, Gill. Lake Michigan Sisco. Found in deep water in Lake Michigan.

*Genus Coregonus, Linn.*

68. *C. albus*, LeS. White-fish. Very abundant in Lake Michigan.

#### FAMILY HYODONTIDAE.

*Genus Hyodon, LeS.*

69. *H. tergisus*, LeS. Moon-eye. Common in Lake Michigan and in all the large streams throughout the state.

#### FAMILY CLUPEIDAE.

*Genus Alosa, Cuv.*

70. *A. sapidissima*, (Wils.) Stor. Common Shad. Has been introduced into one or two streams in the northern part of the state ; but whether it thrives or not, has not been proven.

*Genus Pomolobus, Raf.*

71. *P. chrysochrous*, Raf. Ohio Shad. Found in the Ohio and Mississippi rivers, and sometimes ascends the Illinois. It is also accredited to Lake Michigan by Mr. J. N. Milner.

*Genus Dorosoma, Raf.*

72. *D. notatum*, Raf. Gizzard Shad. Very common in the rivers in the southern and central parts of the state, and, since the opening of the canal connecting the Chicago river with the Illinois, has found its way, with the preceding, into Lake Michigan.

For some time previous to this date, (December 2nd), the young, from three to four inches long, have been frequenting, in considerable numbers, a "slip" extending from the Chicago river to one of the City Water Works buildings. The attraction to the fishes appears to be the hot water which runs into the "slip" from the Water Works engines. As the fishes swim about in this warm water, they strike the hot stream as it flows in, and many are killed. The opening of the above mentioned canal will have considerable influence upon the distribution of the lake and river fishes, and numerous species will in all probability take advantage of the communication between the Mississippi and the great lakes.

This undoubtedly accounts for the occurrence of *Chaenobryttus gulosus* in Lake Michigan, as well as of the two preceding species.

#### FAMILY CYPRINIDAE.

*Genus Campostoma, Ag.*

73. *C. anomalum*, (Raf.) Ag. Stone Roller. Occurs in the greatest abundance throughout the state, although perhaps more rarely in the vicinity

of Lake Michigan. This species, as defined by Prof. Jordan (Man. Vert. An., p. 275), exhibits a great amount of variation, and may eventually be separated into two.

*Genus Pimephales, Raf.*

74. *P. promelas, Raf.* Black-head. Apparently rare. I have examined but three specimens from Illinois: two in the state collection, from Bailey's creek, in Central Illinois, and one in the collection of my friend, Mr. E. L. Rice, obtained near Evanston, in a ditch.

75. *P. milesii, Cope.* Approaches very closely to the preceding species, and one of the central Illinois specimens possesses characters almost intermediate between the two forms.

*Genus Hyborhynchus, Ag.*

76. *H. notatus, (Raf.) Ag.* Blunt-nosed Minnow. Very numerous throughout the state.

*Genus Hybognathus, Ag.*

77. *H. nuchalis, Ag.* Blunt-jawed Minnow. Apparently rather uncommon; a few specimens in the state collection from central Illinois.

78. *H. argyritis, Grd.* Silvery Minnow. Much more numerous than the preceding. Specimens are in state collection, from central Illinois; and Prof. Jordan informs me that it is common in the larger streams in the Wabash and Ohio valleys.

*Genus Ericymba, Cope.*

79. *E. buccata, Cope.* Silver-mouthed Dace. Very abundant in the Wabash valley; but no specimens are in the state collection from the western streams tributary to the Mississippi.

*Genus Semotilus, Raf.*

80. *S. corporalis, (Mitch.) Put.* Horned Dace. Abundant throughout the state.

*Genus Ceratichthys, Bd.*

81. *C. biguttatus, (Kirt.) Bd.* ( $\equiv$  *C. melanotus, Raf.*) Horned Chub. Abundant everywhere.

82. *C. dissimilis, (Kirt.) Cope.* Spotted Shiner. Common in tributaries of the Wabash and Illinois.

*Genus Rhinichthys, Ag.*

83. *R. nasutus, (Ayres) Ag.* Long-nosed Dace. Occurs in tributaries to Lake Michigan. (Jordan.)

84. *R. maxillosus, Cope.* Sharp-nosed Dace. Two specimens in the state collection, from Lake Michigan at Chicago, and another, in my collection, from a small tributary of the lake at Waukegan. This species is at once distinguished from its relatives, by its long slender form, narrow-pointed head and peculiarly shaped head and snout. The body is more nearly cylindrical than usual in this genus.

85. *R. atronotus, (Mitch.) Ag.* Black-nosed Dace. Specimens in the state collection, from tributaries of the Illinois; and others from clear tributaries of Lake Michigan, are in the collection of the author.

86. *R. lunatus*, Cope. Fork-tailed Dace. Specimens from Rock river are in Prof. Jordan's collection.

87. *R. meleagris*, Ag. A very large number of specimens of this species are in the state collection, from Bailey's creek, McLean county, where Prof. Forbes found them in abundance. Agassiz's description is so incomplete that I insert the following from one of the Illinois specimens. The species is well marked, and may be easily recognized. A few specimens were taken in the Vermilion river:

Head 2 2-5 in length: depth  $4\frac{1}{4}$ . Eye small, 5 in head. D. I, 7; A. I, 6. The barbels are long and distinct. The snout projects considerably, overlapping the lower jaw. Dorsal much nearer tail than tip of snout. Upper half of body dark, sharply outlined by the light of the under parts. The dark mottlings are not so profuse as in most of the species. The body is stout, deeper and thicker than in most members of the genus.

*Genus Phenacobius*, Cope.

88. *P. teretulus*, Cope, var. *biosternus*, Nelson. A number of specimens of this form are in the state collection, from small streams in McLean county, where it appears not to be uncommon. The following is the description of the adult:

Head  $4\frac{1}{2}$  in length: depth  $4\frac{3}{4}$ . Eye  $4\frac{1}{2}$  in head. D. I, 7; A. I, 7; ventrals 8. Lateral line 43 to 45: longitudinal rows 5-1: scales in front of dorsal, 16; length 3 inches. Dorsal in front of ventrals, much nearer snout than caudal. Scales in front of dorsal small. Intestine short, peritoneum pale. Head long: mouth inferior, lateral line first decurved, then straight. Pectorals do not extend to ventrals, ventrals reach vent. Teeth 4-4, hooked. Color olive above, sides bright silvery overlying a plumbeous shade; a small but distinct caudal spot. Thoracic region entirely naked. Lips fleshy, as in the *Catostomidae*.

*Genus Hybopsis*, Ag.

89. *H. storerianus*, (Kirt.) Ag. Storer's Minnow. Two specimens in my collection, from Lake Michigan at Chicago. The following is the description of one of the specimens:

Head in length  $4\frac{3}{4}$ ; depth  $4\frac{3}{4}$ : eye in head 3 times, and longer than snout; very large and white. D. I, 8; A. I, 7. Lat. l. 40. Dorsal over ventrals, nearer snout than to caudal: 20 large scales in front of dorsal: lateral line nearly straight: pale above, sides bright silvery; intestine short; peritoneum white. This species presents much the appearance of *amarus*, Grd.

90. *H. hudsonius*, (Clint.) Put. Spawn-eater. Occurs in Lake Michigan. (Jordan.)

91. *H. tuditanus*, Cope. Described from Lake Michigan. I have seen no specimens.

92. *H. stramineus*, Cope. Very common in creeks through central Illinois, and probably occurs elsewhere, but no specimens have been taken.

93. *H. volucellus*, Cope. Specimens have been received from the Rock and Pecatonica rivers, by Prof. H. E. Copeland.



94. *H. fraetensis*, Cope. Specimens in state collection, from Ogle and McLean counties, where it appears to be common.

95. *H. haematurus*, Cope. Tributaries to Lake Michigan. (Jordan.)  
Genus *Hemitremia*, Cope.

96. *H. heterodon*, Cope. Northern *Hemitremia*. Exceedingly numerous in Lake Michigan and the Calumet river. It also occurs in the Fox river at Geneva.

Genus *Chrosomus*, Raf.

97. *C. erythrogaster*, Raf. Red-bellied Minnow. Everywhere common in clear streams. Specimens have been examined from all parts of the state.

Genus *Phoxinus*, Raf.

98. *P. neogaeus*, Cope. New World Minnow. A single specimen obtained in the Fox river at Geneva.

Genus *Gila*, B. & G.

99. *G. elongata*, (Kirt.) Jord. Red-sided Minnow. Found rather sparingly through the state.

Genus *Lythrurus*, Jord.

100. *L. diploemius*, (Raf.) Jord. Red-fin. Rather common through central and southern Illinois, but I have seen no specimens from the northern part, although it may occur.

101. *L. cyanocephalus*, Copeland, Mss. The type specimens were received from the Rock river by Prof. Copeland.

Genus *Lucilus*, Raf.

102. *L. cornutus*, (Mitch.) Jord. Shiner. Everywhere abundant.

Genus *Cyprinella*, Grd. (= *Plargyrus*, Raf.)

103. *C. galacturus*, Cope. Slender Silver-fin. Abundant in Rock-river and tributaries of the Illinois, and south.

Genus *Photogenis*, Cope.

104. *P. scabriceps*, Cope. Rough-headed Shiner. Tributaries of the Wabash and Ohio. (Jordan.)

Genus *Minnilus*, Raf.

105. *M. rubrifrons*, (Cope) Jord. Rosy-faced Minnow. Specimens are in the state collection from the Illinois and several of its tributaries, and it also occurs in the Wabash valley.

106. *M. dilectus*, (Grd.) Jord. Delectable Minnow. This species does not seem to be numerous at any place. A few specimens are in the state collection from Lake Michigan, and others from tributaries of the Illinois in McLean county.

107. *M. amabilis*, (Grd.) Nelson. Four specimens of this species are in the state collection from Pine Creek, Ogle county. The following is a description of one of the above specimens—all being alike:

Head 4 in length; depth  $4\frac{3}{4}$ ; eye equals snout,  $3\frac{1}{2}$  in head. Dorsal I, 7. Lat. l. 39 or 40. Anal I, 10. Olive above, sides bright silvery over-

laying a well defined plumbeous band, along the lower border of which is the lateral line. Body considerably compressed; color usually dark; a dark dorsal stripe; five or six rows of scales above lateral line: traces of a blackish spot at base of caudal: eye moderate. *M. megalops*, (Grd.) Jord. is the nearest relative, from which *amabilis* differs by its smaller eye and more pointed head, besides minor characters. *Megalops* is abundant in the rivers of Georgia, Prof. Jordan informs me.

108. *M. rubellus*, (Ag.) Jord. Rosy Minnow. Exceedingly abundant in Lake Michigan and all the larger streams through the state.

109. *M. dinnemus*, Raf. Emerald Minnow. Very common in the Fox river at Geneva, and occurs in most of the larger streams through the state.

*Genus Notemigonus, Raf.*

110. *N. americanus*, (L.) Jord. Shiner. Abundant everywhere.

*Genus Carassius, Nil.*

111. *C. auratus*, (L.) Bleeker. Gold Fish. This species has become naturalized in several of our rivers.

FAMILY CATOSTOMIDÆ.

*Genus Catostomus, LeS.*

112. *C. teres*, (Mit.) LeS. Common Sucker. Common everywhere throughout the state. A form with a shorter head, and presenting other slight peculiarities occurs in Lake Michigan. This will probably form a variety, but a lack of a sufficient series of specimens has prevented any satisfactory conclusion being reached.

113. *C. hudsonius*, LeS. Northern Sucker. A single specimen of this species is in the state collection from Rock river, at Oregon. In this specimen the head is 4 in length: the lat. l. 100: D. 11: A. 7: thus answering closely to Agassiz's *C. aurora*.\*

*Genus Hypentelium, Raf.*

114. *H. nigricans*, (LeS.) Jord. Hammer-head. Abundant everywhere throughout the state.

*Genus Erimyzon, Jord.*

115. *E. oblongus*, (Mit.) Jord. Chub Sucker. Common in Lake Michigan and most of the rivers throughout the state. The young of this species have the fins tinged with red, and possess a jet-black lateral band.

116. *E. melanops*, (Raf.) Jord. Striped Sucker. Common throughout the state. One of the main characters upon which this genus is based proves to be very uncertain, i. e., the absence of the lateral line. In the state collection are specimens of this species which are entirely without a trace of the lateral line: others possess it upon one side only, and others have it upon both sides—generally more or less interrupted, however. Other characters are present which will sustain the separation of this group from related genera, unless new points of connection should be observed.

\*Lake Superior, p. 360. pl. II.

Genus *Teretulus*, Raf. (= *Moxostoma*, Raf.)

117. *T. duquesnii*, (LeS.) Cope. Red-horse. Common throughout the state.

118. *T. aureolum*, (LeS.) Raf. Golden Mullet. Abundant in Lake Michigan and the Calumet river.

119. *T. anisurus*, (Raf.) Nelson. Carp Mullet. Specimens are in the state collection from the Illinois river.

120. *T. macrolepidotum*, (LeS.) Nelson. Apparently not very common. Specimens in the state collection, from the Illinois and Wabash rivers. (Jordan.)

121. *T. carpio*, (Val.) Nelson. Silvery Mullet. Lake Michigan and the larger rivers. Not common.

122. *T. velatum*, (Cope) Nelson. Common in all the larger tributaries of the Illinois and Mississippi.

Genus *Placopharynx*, Cope.

123. *P. carinatus*, Cope. Cope's Sucker. Common in the Wabash river. (Jordan.)

Genus *Ichthyobus*, Raf.

There can be no doubt of the propriety of uniting the two genera *Ichthyobus* and *Carpiodes*, since a series of specimens will form so complete a junction between the characters assigned to each that it is impossible to distinguish the dividing line. They have already been united by Prof. Cope, but as *Ichthyobus* has priority over *Carpiodes*, it must stand instead of the latter. The following is the relation in which they were first issued :

*Ictiobus*, Raf. Ich. Oh., 1820, p. 55, n. subg., type *Ambloodon bubalus*, Raf., 1818. *Carpiodes*, Raf. Ich. Oh., 1820, p. 56, n. subg., type *Catost. cyprinus*, LeS., 1818.

124. *I. velifer*, (Raf.) Nelson. Sail Fish. Not uncommon in the Ohio and Mississippi rivers. Specimens in the state collection.

125. *I. difformis*, (Cope.) Nelson. Found in Lake Michigan and the large rivers through the state.

126. *I. bison*, (Ag.) Nelson. Buffalo Carp. Found in the large rivers.

127. *I. thompsoni*, (Ag.) Nelson. Lake Carp. Common in Lake Michigan.

128. *I. carpio*, (Raf.) Nelson. Olive Carp Sucker. A single specimen seen from the Ohio river at Cairo.

129. *I. bubalus*, (Raf.) Ag. Brown Buffalo. Common in all the large rivers through the state.

130. *I. cyanellus*, sp. nov. Blue Buffalo. A number of specimens of this species are in the state collection, from the Illinois river, and in Prof. Jordan's collection, from the Mississippi at St. Louis. The following is the description, taken from several specimens, measuring from 8 to 9¼ inches in length :

Head about 3½ in length. Depth 2½ to 2 5-6. Eye 4½ to 5½ in head. Dorsal I, 30 and I, 8. Ventrals 10. Lat. l. 38. Longitudinal rows 7-5 to 7-6. Body compressed, high. Anteriorly broad, compressed be-

hind. Longest ray reaching 18th ray. Pectorals shorter than ventrals, both shorter than head. Anal scarcely reaching caudal; head very short, high and thick; its thickness  $\frac{2}{3}$  length, depth 1 1-5 in length. Mouth quite small, oblique, and overlapped by a slightly projecting snout. Mandible short, 4 in head. Opercle becoming wrinkled with age. Head small, short and thick; muzzle obtuse, conic, not twice the length of eye. Anterior ray of dorsal, in type from Illinois river, slightly nearer snout than base of caudal. In specimens from St. Louis the dorsal is about equi-distant. Color above light steel blue in adults, becoming lighter below. Young lighter with distinct stripes along the rows of scales. Although the species is described from specimens but nine inches long, when fully grown it undoubtedly reaches similar dimensions to its congeners.

*Genus Bubalichthys, Ag.*

131. *B. niger*, (Raf.) Ag. Buffalo Fish. Rather common in the large rivers throughout the state.

*Genus Cycleptus, Raf.*

132. *C. elongatus*, (LeS.) Ag. Black-horse. Occurs in the large rivers throughout the state.

FAMILY SILURIDAE.

*Genus Ictalurus, Raf.*

133. *I. punctatus*, (Raf.) Jord. Channel Cat. Occurs more or less commonly throughout the state.

134. *I. furcatus*, (LeS.) Gill. Great Fork-tailed Cat. Occurs in the large rivers in the western and southern parts.

*Genus Amiurus, Raf.*

135. *A. confinis*, (Grd.) Gill. Several specimens are in the state collection from the Illinois and tributaries, where it is rather common.

136. *A. pullus*, (DeK.) Gill. Black Bull-head. Several specimens in the state collection from the Illinois and tributaries. Not uncommon.

137. *A. atrarius*, (DeK.) Gill. Northern Bull-head. Common in Lake Michigan and rivers in the northern part of the state.

138. *A. albidus*, (LeS.) Gill. Brown Cat Fish. Our commonest species; abundant throughout the state.

139. *A. vulgaris*, (Thomp.) Nelson. (= *A. dekayi*, Gir. and *A. aelurus*, Gir.) A few specimens have been taken in tributaries of the Illinois in the central part of the state.

140. *A. cupreus*, (Raf.) Gill. Yellow Cat. Common in the Illinois and tributaries, and south.

*Genus Hopladelphus, Raf.*

141. *H. olivaris*, (Raf.) Gill. Mud Cat. Not uncommon in the Ohio and Mississippi rivers.

*Genus Noturus, Raf.*

142. *N. flavus*, Raf. Very common throughout the state.

143. *N. marginatus*, Baird. Margined Cat. Common in the Wabash valley and south. (Jordan.)



144. *N. exilis*, sp. nov. Slender Cat. Rare. Three specimens were obtained in McLean county by Prof. Forbes, the only ones seen. These specimens present the following characteristics:

Head in length  $4\frac{1}{4}$ ; depth  $6\frac{1}{2}$  in length. Eye  $4\frac{3}{4}$  in head. Dorsal I, 6; Anal I, 5. Ventrals 8 or 9. Inter-orbital space  $3\frac{1}{4}$  in length of head. Dorsal a trifle nearer snout than anal. From snout to dorsal  $3\frac{1}{2}$  in total length. Dorsal as high as long, and  $1\frac{3}{4}$  in head. Dorsal spine small,  $3\frac{1}{4}$  in head. Pectoral spine  $2\frac{1}{2}$  in head. Width of head  $1\frac{1}{8}$  in length; depth  $2\frac{1}{2}$  in length of head. Base of anal  $1\frac{1}{2}$  in head.

FAMILY ANGUILLIDAE.

*Genus Anguilla, Thunb.*

145. *A. vulgaris*, var. *rostrata*, (LeS.) Nelson. Common Eel. Occurs in Lake Michigan and most of the larger streams through the state, but is far from common anywhere.

FAMILY AMIIDAE.

*Genus Amia, Linn.*

146. *A. calva*, L. Dog Fish. Abundant throughout the state.

FAMILY LEPIDOSTEIDAE.

*Genus Lepidosteus, Lac.*

147. *L. osseus*, (L.) Ag. Gar Pike. This is far the most common species in Lake Michigan and the Calumet river, where it is very abundant. It also occurs throughout the state.

148. *L. platystomus*, Raf. Short-nosed Gar. Occurs throughout the state, but is much more abundant in Illinois and south.

*Genus Litholepis, Raf.*

149. *L. adamanteus*, Raf. Alligator Gar. Common in the Ohio and Mississippi rivers, occasionally straying up smaller rivers into the interior of the state.

FAMILY POLYODONTIDAE.

*Genus Polyodon, Lac.*

150. *P. folium*, Lac. Duck-billed Cat. Common in central and southern Illinois in the larger streams. Rare in the northern part of the state.

FAMILY ACIPENSERIDAE.

*Genus Acipenser, Linn.*

151. *A. maculosus*, LeS. Sturgeon. Very abundant in Lake Michigan and the larger rivers throughout the state.

152. *A. rubicundus*, LeS. Lake Sturgeon. Very common in Lake Michigan, ascending Calumet river in winter.

*Genus Scaphirhynchops, Gill.*

153. *S. platyrhynchus*, (Raf.) Gill. Shovel-nosed Sturgeon. Common in the southern part of the state in the Ohio and Mississippi rivers.

FAMILY PETROMYZONTIDAE.

*Genus Petromyzon, Linn.*

154. *P. niger, Raf.* Small Black Lamprey. Very common in many localities through northern Illinois, ascending small streams in spring from Lake Michigan and the rivers.

*Genus Ichthyomyzon, Gir.*

155. *I. argenteus, (Kirt.) Grd.* Silvery Lamprey. Lake Michigan and large rivers throughout the state.

156. *I. hirudo, Grd.* A single specimen in the state collection from the Ohio at Cairo.

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## UPON PARASITIC FUNGI.

BY T. J. BURRILL,

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Many doubt the action of microscopic fungi in causing diseases of higher plants and animals. Indeed it has only been in our century, and mostly in the latter part of it, that botanists have distinguished these minute parasites as independent plants. Schleiden (1) in a work written about 1845 said, "I cannot regard the true Uredines, etc., (*Coniomyctes*) as independent plants. Meyen (2) observed the formation of *Uredo maidis* as an abnormal process of cell formation in the interior of the cells of the parent plant; and, in this respect, my own observations on *Elymus arenarius* coincide with his." Unger (3) in 1833 sought to prove that the so-called fungi were changed conditions of diseased tissues; and Fries in a classic work upon fungi, holds similar views.

But the matter is not left undecided. The improvements in microscopes, and in methods of tracing the life history of low organisms, have forever settled the doubts in the minds of scientific men. Nothing can be more satisfactory in the way of evidence, than to see with one's own eyes the spores germinating, penetrating the plant tissues, and in due time producing again spores like the original ones. This has been done again and again, and may be seen by any one who will take the trouble to follow, day by day, the development of any of the hundreds always and everywhere at hand. Their

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1. Principles of Scientific Botany. London, 1849. p. 151.

2. Ueber die Entwickelung des Getreidebrandes in der Mais-Pflanzen. Weigmanns Archiv., 1837, p. 419.

3. Die Exantheme des Pflanzen, Wein, 1833, p. 356.

effects, likewise, may thus be observed, obliging the most skeptical to admit the agency of the parasites in causing the malady to which attention is given.

Probably Prevost first discovered the fact, that the spores of fungi germinate. This was in the first decade of our century. Since then many eminent naturalists have given abundant testimony as to the true parasitism of species, and of their individuality as such. We may, without disparagement to others, mention the names of Leville (4), Tulasne (5), Berkeley (6), and M. Bary (7) as authorities, whose writings have conclusively established the fact that these parasites do cause the maladies attributed to them. Robin (8) and Leidy (9) have published prominent treatises on the vegetable parasites upon living animals.

Observers in this field are now much more numerous than ever before and, having the advantage of the former contributions, are gaining rapidly in the knowledge of kinds and of the injuries caused by these small but in no wise insignificant organisms. Preventives and cures naturally follow investigations of cause. They certainly cannot precede the latter except by accident; hence, if any one feels like asking "What use?" let him possess himself in patience;—in the coming time, man will assert his dominion here as well as elsewhere over the natural world. Something has already been done. The vine disease in Europe has been kept down by the use of sulphur, as are the rose and verbenæ mildews in green-houses. Sometimes prevention is attained by removing promptly attacked parts, as in the case of the peach-rot, and, as further detailed below, sometimes by destroying the spores of the fungus, as in the bunt of wheat. Cultivators now often unconsciously scatter the germs and ignorantly provide ways and means for their development. The march or migration of a parasite of this kind is sometimes as well marked as that of an injurious species of insect.

*Puccinia malvacearum*, Mont., affecting cultivated hollyhocks, has been traced from South America through the United States to England and thence to the continent as certainly as the Colorado potato beetle has across our territory. Timely, intelligent action in such cases might avert great disaster. Had this fungus attacked the cotton plant, as it was feared it would, what estimate could be placed upon the loss! What money-value is destroyed in our own state by rust (*Puccinia graminis*, Pers.) on wheat, oats, etc.: what discouraging losses by the multitudinous blights upon our cultivated crops, many of which are known, and others supposed to be, caused by parasitic fungi!

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4. Annales des Sc. Naturelles, 1839, etc.; and "Mycologie," and "Uredines," in Dict. d'Hist. Nat., par D'Orbigny.

5. Annales des Sc. Naturelles, 3 ser., tome VII, 1847; 4 ser., tome II, 1854.

6. Introduction to Cryptogamic Botany, London, 1857, p. 261. Outlines of British Fungology, London, 1860, p. 68.

7. Ueber der Brandpilze, 1853. Morphologie und Physiologie der Pilze, 1866, and many papers in Annales des Sciences Naturelles and elsewhere.

8. Histoire Naturelle des Vegetaux Parasites qui croissent sur l'homme et sur les animaux vivants, par Charles Robin, Paris, 1853.

9. A Flora and Fauna Within Living Animals, by Joseph Leidy, Smithsonian Cont. to Knowl., Vol. 5, 1853.

Aside from what may be called the practical value of the study, including that which leads to the better understanding of the higher forms of living things, these microscopic creations have many attractions for the student. Nature is always, and to every one, interesting; her pursuit is alluring in the highest degree. To see rare forms men traverse oceans and make pilgrimages over continents: but here are countless unseen living things, under our feet, on every side, in the air we breathe, in the food we eat, on plants, on animals, germinating and propagating under our own finger nails and even in our mouths, possessing a variety of form and structure, often curious and beautiful, never equalled by art and not surpassed in nature. Their wonderful life-histories stimulate inquiry, engage and enchain the attention. He who possesses a microscope, with the ability and opportunity to use it, need never wander from his own door to find an abundance of material awaiting his researches, and entertaining and instructive biographies ready for his pursuit. (10.)

THE PERONOSPORAÆ. (11). Among the pests to the cultivators of fields and gardens, the members of this family maintain a bad pre-eminence. None have attracted more attention from the injuries they do to important plants, and from their peculiar and interesting life-history. Formerly classed in widely different groups on account of their difference in structure, the species have been united from their agreement in development. All produce *conidia*,—naked spores borne upon the tips of erect filaments or *hyphæ*,—which in some cases germinate directly and sometimes give origin to some half-dozen *zoospores*. The latter are small, more or less globular bodies, capable of rapid movements in water by means of two long cilia, which they lash from side to side with astonishing rapidity. They thus swim in a drop of rain or dew some minutes or hours; then, losing the propelling hairs, settle down, and under favorable circumstances germinate like the conidia by protruding one or more slender tubes, which penetrate the tissues of the supporting plant and become the *mycelium* or vegetative threads of the fungus. Besides, through the conidia and their offspring, the zoospores, these particular plants have another method of reproduction. The term *oospore* has been given to a fruit-body found to arise from the conjoined action of two separate cells of the mycelium. This is a sexual process well known among the *algæ* or sea-weeds, but not yet well made out in most fungi, and analogous to the production of seed in flowering plants by the united action of stamen and pistil. The cell producing the oospore is called a *gonosphere* or *oogonium*, and its partner an *antheridium*. The oospores are found on or in the tissues of the host, sometimes only upon one of several plants that the conidia are found upon. Unlike the latter, they lie dormant for some months, but, like them, finally give origin to

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10. Cooke's little book on Rust, Smut, Mildew and Mould is an excellent one for a beginner.

11. The plants enumerated in this paper are from collections made by the author between September 21st and October 16th, 1876, mostly from the area of ground upon which he makes his home. Any collector will perceive that more of the Uredines and other families are omitted than are mentioned.



zoospores which appear identical with those produced by the conidia. The office of the oospore appears to be to pass the winter. The family consists of two genera, *Peronospora* and *Cystopus*. The species of the former have the appearance of moulds, producing conidia singly or in clusters at the tips of the fertile threads, while those of the latter occur as white pustules on leaves, bearing the conidia in moniliform strings, the fertile hyphae or threads having no prominence. Generally the mycelium of both has curious processes, termed *haustoria*, penetrating the cells of the supporting plant, as shown in Plate II, Fig 7. The threads themselves, when first emitted from the spore as well as when buried and ramified in the tissues, often penetrate the cell through and through, being found at considerable distances from the diseased-looking spots upon which the fruiting threads appear.

Over forty species of *Peronospora* have been described, of which only six are known to exist in the United States. Many others probably await the researches of botanists. Of the six, three, by far the most common ones, are in the present described collection.

*Peronospora infestans*, Mont., (Plate II, Fig. 8.) Very common on potatoes and tomatoes. It has also been found on Bittersweet (*Solanum dulcamara*), and even upon a not closely related plant, *Anthocercis viscosa* (12) belonging to the *Scrophulariaceæ*. This is by far the most famous, or infamous, of the species of this genus, causing the well known and often dreaded potato rot. Its history has been often told (13), but a new chapter was added last year by Worthington G. Smith (14), of England. Previously the oospores had not been found as such, and so much search had been made for them that it was quite generally believed that they must exist upon some other supporting plant. Clover, among others, was suspected. The finding of them in the tissues of the leaves and stalks of the potato settled the doubt and bids growers beware of leaving the old potato top to breed the pestilence another year.

*P. gangliiformis*, Berk., (Plate II, Fig. 3.) Common on lettuce and some allied compositæ (*Lactuca altissima* and *Nabalus albus*. Farlow.) Zoospores not observed. Conidia germinating and penetrating young leaves, the tissues usually decaying from above downward until the whole plant is involved and becomes a slushy, putrescent mass. This parasite is especially destructive in forcing-houses. Several hundred dollars worth of lettuce was lost by one propagator here last winter from this fungus (15). The only cure now known is to keep the atmosphere as dry as practicable and remove very carefully the diseased leaves.

*P. viticola*, B. & C. (Plate II, Figs. 6 & 7.) Common on grape leaves, and becoming very destructive in this vicinity, worse apparently

12. Farlow. Synopsis of the Peronosporæ of the United States. Bulletin of the Bussey Institution, p. 426.

13. Smith. Ohio Ag. Report. 1872, Essays, etc., p. 20.

14. Farlow. Gardener's Monthly, Nov. 1875, p. 274. Smith. Ohio Ag. Report, 1862, Essays, etc., p. 20.

15. Smith. Gardener's Chronicle, July 17, 1875, p. 69. Quarterly Journal of Microscopic Science, October, 1875.

16. Farlow on the American Grape Vine Disease. Bulletin Bussey Institution, p. 415.

upon the smooth-leaf varieties. The Clintons were nearly or quite killed by it the last two summers. This seems to be a native American, and has often been mistaken for *Erysiphe tuckeri*, Berk, which constitutes the vine disease in Europe,—a mistake which has led to an error and disappointment in its treatment. Sulphur proves effectual in case of the *Erysiphe*, but it lives upon the surface of the leaf, not in the tissues, as does our plant. Notwithstanding the continued failures, cultivators still are known who spend their time and money with the sulphur remedy, showing again the importance of the knowledge of the species and their habits. But, unfortunately, a practicable remedy is not now known. The conidia produce zoospores, which swim in water some fifteen minutes, then germinate. The oospores are found among the cells of the leaf in autumn. If all the old diseased leaves could be burned, a preventive would be attained.

During the last winter (1874-5) a parasite (Plate I, Figs. 5, 6, 7, 8, 9, 10, 11) was noticed upon many of the plants in the green-house belonging to the Illinois Industrial University. A few of the diseased leaves being taken home for examination, although they were exposed but a few minutes in a room with previously healthy window plants, the same disease soon appeared upon the latter;—a case of the unwitting distribution of disease germs by man. Our real study of this species commenced, however, in October, 1876, when it reappeared in both the localities just named. In one case a box of earth in which some affected plants grew last year (winter of '75-6) was left dry during the summer and some healthy plants replaced in the box in October, 1876. Every care practicable was taken to see that these plants were sound and to exclude infection from any other source. In a week's time there was evidence in abundance of the same parasite. The conidia are now known to germinate when at least one month old, but did they lie dormant all summer? Supposed oospores were found in the petals of *Salvias*, and figured (Plate I. Fig. 10.) This body is 1-500 in. in diameter, with an apparent hyaline reticulated epispore and a yellowish included spheroid. The fertile hyphæ are dingy or smoky colored, torulose when dry, septate, simple or branched, bearing conidia in dense clusters on the sides and tips of the rigid, blunt extremities. Conidia oval, pappillate, slightly tinted, 1-1800 by 1-2660 in. Believing the plant to be an undescribed *Peronospora*, it was christened *P. fumosa*; but later examination, since the figure was made, makes it questionable about the so-called oospore being such. If not, the plant may belong to the aforesaid related genus *Poltactis*, Link, in which case its parasitism on living plants is an anomaly. The conidia germinate in water, often emitting two or three tubes. Zoospores not seen. On the leaf the germinating tubes run over the surface or penetrate through the cells to the interior. In about five days from the sowing, the fertile hyphæ appear with their conidia. They arise from the stomata or from the external mycelium. Sometimes the conidial hyphæ do not appear until the leaf or young stem is in an advanced state of decay. On some plants only unhealthy or fallen leaves appear to be affected. *Salvias*, *Geraniums*, *Centaureas*, *Senecios* and others of diverse orders suffer from its attacks, while as many as twenty kinds have been found living or dead with the fungus upon them. Had time

permitted, I should have been glad to submit this plant to the inspection of others before, perhaps, thus exposing my own ineapacity. The only similar figure which I have seen is in Schleiden's Principles of Scientific Botany, London, 1849, Plate 2, Fig. 8. This cannot be the plant.

Of the four recorded United States species of *Cystopus*, three were found. These are exceedingly common on the plants indicated. They do not, however, have the blighting effect of the *Peronosporia*. Plants thoroughly dotted with their pustules appeared to survive without great injury. Their microscopical character is so well known to botanists that nothing would have been gained by selecting new specimens to figure, so in my haste copies were selected as indicated. The other figures are from the collection, but none of the plants are more common than these.

*Cystopus candidus*, Lev., (Plate I, Figs. 1, 2, 3, 4.) Common on cruciferous plants, notably here on horse radish and cabbage.

*C. cubicus*, Mart. On *Ambrosia artemisiæfolia*, the common rag weed.

*C. bliti*, Bivon. On *Portulaca oleracea* (purslane) and *Amaranthus retroflexus*.

PERISPORIACEI. Notwithstanding the similarity of the names of these families, the plants are very different, as a glance at the plates will show. They, however, agree in their injuries to living plants, constituting very many of the leaf blights of this and other countries. Some of them are most exquisitely beautiful under the magnifier, a thing which the disciples of the development theory of species have not yet accounted for. Their beauty surely does not come from natural or sexual selection. The mycelium runs over the surface of the leaves, never appearing to enter the cellular structure, yet, in some way, deriving nourishment from it. Here applications, as of sulphur, have direct effect. Here, too, the vine and the hop mildews belong. *Conidia* are borne in moniliform strings arising from the mycelium. The two together often give the affected leaves a dusty, whitened appearance, as if coated with whitewash. Later the spherical bodies—*conoeptacles*—of dark color, as represented in the plates, are formed, sometimes exceedingly numerous, sometimes few and hard to find. The *conoeptacles* have not yet been discovered in the vine disease of Europe. These *conoeptacles* have at length radiating *appendages*, different from the mycelium, of many different forms, though constant within narrow limits in a given species. Inside the usually reticulated *conoeptacles* there are attached to the base one or more *sporangia* or spore-sacks. These are thin and transparent, showing plainly the few or many spores. Sometimes, instead of *sporangia*, multitudes of naked and smaller spore-like forms are found; and sometimes similar ones are contained in a stalked flask-shaped or urn-shaped vessel, as seen in Plate III, Fig. 7. Still other apparent fruit-bodies are found on the mycelium or the appendages of the *conoeptacles*. I do not remember seeing these described, but have often met them and am fully convinced that they belong to the same plants. They are dark-colored like the *Dematiei* species, and of the forms shown in Plate III, Figs. 2b, 2e, 2d, 7f, and Plate IV, Fig. 12. Save in quantity, they are not unlike forms of the black mildews found on thick-leaved plants and known



under the names *Fumago*, *Antennaria*, *Capnodium*, etc., but their positive connection with these plants, positive at least in the case of the specimen figured in Plate III, Fig. 2, of course destroys any sort of specific individuality. I cannot say that they are reproductive bodies, but they certainly look like it. Other plants not distantly related have such forms of fruit. It is probable that the conceptacle, with its contained sporangia, in all these plants, is the result of a peculiar union of specialized cells (17), as in the *Peronosporiæ*.

*Sphaerotheca castagnei*, *Lev.* On *Taraxicum*, *Hop*, *Spiræa*, etc. To this species we refer with doubt the plant figured on Plate III, Fig. 3, found on *Erechtites hieracifolius*, but the conceptacle is larger (1-245 in.) and the mycelium denser than in any undoubted plants of the species noticed, and the appendages somewhat different. Instead, too, of being distributed over the plant, this is found almost entirely upon the stems and under sides of the leaves, in patches. Appendages (of which there are one to three) colored to a septum. Sporangium one, spores eight, oval, 1-8000 by 1-4300 in.

*Phyllactinia guttata*, *Lev.*, (Plate IV, Fig. 6.) Common on *Fraxinus viridis*. This species is reported to be common on *Quercus*, *Carpinus*, *Berberis*, *Alnus*, *Corylus*, etc.

*Podosphaera kunzei* (?), *Lev.* (Plate III, Fig. 2.) On cultivated cherry. This is almost surely not *kunzei*, *Lev.*, but it is the nearest to it of any I know and I am loth to call it new, since so conspicuous and injurious a species could hardly have escaped attention. Leaves of all varieties of cultivated cherries were distorted and caused to fall, from the middle of the summer until autumn. My notes are as follows: Mycelium thin, evanescent: appendages about twelve, colored at base, sometimes septate, simple or but little dichotomously forked: conceptacle black, 1-300 in., gregarious on the upper side of leaves. Sporangium eight-spored. The spore-like forms on the appendages have already been referred to. These were by no means on all the plants, but occurred on this one as shown.

*Microsphaeria extensa*, *C. & P.*, (Plate IV, Fig. 2.) On *Quercus rubra* and *Q. palustris* in woods. The upper sides of the leaves are conspicuously whitened.

*M. friesii*, *Lev.* Very common on *Syringa vulgaris*. The conceptacles are sometimes abundant, but not always. The divided and curled tips of the appendages are very beautiful in perfect specimens.

*M. rarenetii*, *Berk.*, (Plate IV, Figs. 7 to 11.) On *Gleditchia triacanthos*. This is certainly the same as my specimen in *Ravenel's exsiccati*, but the mycelium is much more dense. In this respect it surpasses all I have seen. The leaves are very white.

*M. elevata*, *n. sp.*, (Plate II, Fig. 4.) Upper sides of leaves of *Catalpa bignonioides*. Mycelium thin, web-like, rather evanescent. Conceptacles 1-250 in., conspicuously reticulated, raised from the leaf; appendages about twelve, colored at base, often simple, sometimes branched near the base, usually 2 to 4 times dichotomously forked, very long; sporangia four,

17. Sachs' Text Book of Botany, English Ed., 1875, p. 256.



oval, strongly rostrate. This appears to be so distinct from any description given that I have named it as new. Not uncommon.

*Erysiphe*, ——— (Plate IV, Fig. 1.) On *Aster puniceus*. One conceptacle alone found.

*E. lamprocarpa*, Lev. On Phlox (Old Maid's Pink.)

*E. martii*, Lk. Very common on leaves and stems of peas. The cultivation of garden peas in late summer and autumn is precluded from the effects of this fungus as much as from the weevil which infests them.

*Erotium herbariorum*, Lk. On plants in cabinet. Common everywhere.

These are all that were found in these two families, except one of the latter on leaves of *Liriodendron tulipifera*, which was not matured enough to determine. *Botryopium pulchrum* should not have been given among the parasitic plants, as it is only found on decaying herbage. The figure is more slender and the branches longer than Cooke's figure. The species may not be correct. Fear of occupying too much space causes the omission of further notes.

## A LIST OF THE ORTHOPTERA OF ILLINOIS.

By CYRUS THOMAS, PH. D.

### FAM. 1. FORFICULIDÆ.

#### 1. *Forficula aculeata*, SCUDD.

Found in northern Illinois. It is probable that *Lebia minor*, Linn, may be found in the state, but I am not aware that it has been met with here.

### FAM. 2. BLATTIDÆ.

#### 2. *Phyllodromia germanica*, LINN.

*Blatta germanica*, Linn. Syst. Nat., II, 688.

*Ectobia germanica*, West. Introd., I, 515.

*Phylladromia germanica*, Serv. Orth., 187.

#### 3. *Ischnoptera unicolor*, SCUDD.

*Platamodes unicolor*, Scudd., Bost Jour. Nat. Hist., VII, 417.

*Ectobia lithophila*, Scudd., Bost. Jour. Nat. Hist., VII, 418.

*Ischnoptera uhleriana*, Sauss., Rev. et Mag. Zool., 1862, 169.

#### 4. *I. pennsylvanica*, DEG.

*Blatta pennsylvanica*, Deg., 1773, Mem., III, No. 2, Pl. 44, 4.

*Ischnoptera morio*?, Burm. Hanb., II, 500.

*conloniana*, Sauss., Rev. et Mag. Zool., 1862, 169.

*Platamodes pennsylvanica*, Scudd., Bost. Jour. Nat. Hist., VII, 417.

This is the most common species in the southern part of the state.

5. *Periplaneta orientalis*, LINN.

*Blatta orientalis*, Linn., 1745, Faun. Succ., 862.

“ *culinaris*, Deg., Ins., III, 334.

*Periplaneta orientalis*, Burm. Hanb., II, 504.

*Kakerlak orientalis*, Serv. Orth., 72.

*Stylopyga orientalis*, Fisch. de W. Orth. Ross., 70.

6. *P. americana*, LINN.

*Blatta americana*, Linn., 1766, Syst. Nat., II, 687.

*Kakerlak americana*, Brulle, Hist. Nat. Orth., IX, 53.

*Periplaneta americana*, Burm., Hanb., II, 503.

It is probable that *Ectobia flavocincta*, Scudd., is found in the northern part of the state.

## FAM. 3. MANTIDÆ.

7. *Stagmomantis carolina*, LINN.

*Gryllus carolinus*, Linn., Amœn Acad., VI, 1763, 396.

*Mantis carolina*, Linn., Syst. Nat., II, 1767, 691.

“ *irrorata*, Linn., Syst. Nat., II, 690.

“ *conspurecata*, Serv., Orth., 1839, 190.

“ *inquinata*, Serv., Orth., 1839, 191.

“ *tolteca*, Sauss., Rev. et Mag. Zool., XIII, 1861, 127.

*Stagmomantis tolteca*, Sauss., Bull. Ent. Swiss., III, 1869.

“ *carolina*, Sauss., Mem. Hist. Nat. Mex., IV, 1871, 46.

Found only in the southern part of the state. A species very closely allied to or identical with *Stagmomantis* (*Stagmatoptera*) *minor*, Scudd., is found in the state, but the specimens I have seen were so immature or so imperfect that I could not decide with certainty.

## FAM. 4. PHASMIDÆ.

8. *Diapheromera femorata*, SAY.

*Spectrum femoratum*, Say, Appd. to Long's Exp., 1824, 297.

(See Say's Entom., Sec. Ed., I, 82 & 197.)

*Diapheromera sayi*, Gray, Synop. Phas., 18, 1835.

*Bracteria* (*Bacunculus*) *sayi*, Burm. Hand., II, 566, 1838.

9. *D. velii*, WALSH, Proc. Ent. Soc. Phila., III, 410.10 ? *Anisomorpha buprestoides*, STOLL.

*Spectrum bivittatum*, Say, Am. Ent., Sec. Ed., I, 82.

*Phasma buprestoides*, Stoll, Rep. des Spec., 68, pl. XXIII, p. 87.

*Anisomorpha buprestoides*, Gray, Synop. Phas., 19.

This species is included with much doubt. It has been observed in Kentucky, and although I have no Illinois specimen at hand, I feel quite sure that I have seen a specimen captured in the extreme southern part of this state.

## FAM. 5. ACRIDIDÆ.

## Sub-fam. ACRIDINÆ.

## Group TRYXALINI.

11. *Tryxalis brevicornis*, LINN.

*Gryllus* (*Acerida*) *brevicornis*, Linn., Syst. Nat., II, 692.

*Truxalis brevicornis*, Fabr., Ent. Syst., II, 27.

(*f.*) *viridulus*, Pal. Beauv., Ins. Orth., 81, Pl. 3, Fig. 4.

(*m.*) *notochlorus*, Pal. Beauv., Ins. Orth., 80, Pl. 3, Fig. 3.

*Aceridium ensicornu*, Deg. Ins., 3, 499, Pl. 42, Fig. 7.

*Opsomala punctipennis*, Thos., Trans. Ill. St. Ag. Soc., V, 447.

*Pyrgomorpha brevicornis*, Walk., Cat. Dermap. Salt., III, 500.

*punctipennis*, Thos., Synop. Acrid., 68.

I have found this species at but one place in Illinois, and that a very small area in Jackson county.

12. *T. viridis*, SCUDD.

*Chlocaltis viridis*, Scudd., Bost. Jour. Nat. Hist., 1862, VII, 455.

*Opsomala brevipennis*, Thos., Trans. Ill. Ag. Soc., V, 451.

*Chrysochraon viridis*, Thos., Synop. Acrid., 71.

*Truxalis angusticornis*, Stal., Recens. Orth., I, 105.

Found throughout the state.

13. *T. conspersus*, HARR

*Chlocaltis conspersa*, Harr. Rep., Ed. 1862, 184.

*abortiva*, Harr. Rep., Ed. 1862, 184.

*Stenobothrus melanopleurus*, Scudd., Bost. Jour. Nat. Hist., 1862, VII, 456.

*Chrysochraon conspersum*, Thos., Synop. Acrid., 76.

Occasionally met with in various parts of the state; not common. This and the preceding (*T. viridis*) are in all probability varieties of one species.

14. *Stenobothrus admirabilis*, UHLER.

(*f.*) *St. admirabilis*, Uhler., Proc. Ent. Soc. Phila., 1864, 553.

(*m.*) Thos., Synop. Acrid., 85, (1873.)

Found throughout the state, but not abundant.

15. *St. maculipennis*, SCUDD., Bost. Jour. Nat. Hist., 1862, VII, 458

Found in the northern portion of the state. *St. aequalis* and *St. propinquans* are but varieties of this species.

16. *St. curtipennis*, HARR

*Locusta curtipennis*, Harr. Cat. Ins. Mass., 56.

*Chlocaltis curtipennis*, Harr. Rept., Ed. 1862, 184, Pl. 3, Fig. 1.

*Stenobothrus longipennis*, Scudd., Bost. Jour. Nat. Hist., VII, 457.

Quite common, especially in the northern and central parts of the state, the long-winged variety appearing to predominate in the central part of the state, at least as far as my observations have extended.

*Group OEDIPODINI.*

17. *Stetheophyma gracilis* ?, SCUDD.

*Acreptera gracilis*, Scudd., Bost. Jour. Nat. Hist., VII, 463.

*Stetheophyma gracilis*, Thos., Synop. Aerid., 99.

I have seen but a single specimen of this genus captured in Illinois; it was taken in the extreme northern portion. I saw it but for a short time and am not positive as to the species.

18. *Tragocephala viridifasciata*, HARR

1. *Variety virginiana*, Fabr.

*Gryllus virginianus*, Fabr. Syst. Ent., 291.

(*Locusta*) *virginianus*, Goeze. Ent. Beitr., II, 106.

*Aceridium virginianum*, Oliv. Encey. Meth., Ins. VI, 225.

(*Oedipoda*) *virginianum*, DeHaan. Bijdr. Kenn. Orth., 143.

*Oedipoda virginiana*, Burm. Hanb. Ent., II, 645.

*Gryllus* (*Locusta*) *viridifasciatus*, Goez. Beitr., II, 115.

*Aerydium viridifasciatum*, Deg., Mem., III, 498.

*Locusta viridifasciata*, Harr., Cat. Ins., 56.

(*Tragocephala*) *viridifasciata*, Harr. Rep., Ed. 1862, 182.

*Gomphocerus viridifasciatus*, Uhler, in Harr., Ed. 1862, 181.

*Tragocephala viridifasciata*, Scudd., Bost. Jour. Nat. Hist., VII, 461.

*Gryllus* (*Locusta*) *chrysomelus*, Gmel, Linn. Syst. Nat., IV, 2086.

*Aceridium marginatum*, Oliv. Encey. Meth., Ins. VI, 229.

*hemipterum*, Pal. Beauv., Ins., 145.

2. *Variety infuscata*, Harr.

*Locusta* (*Tragocephala*) *infuscata*, Harr. Rep., Ed. 1862, 181.

*Gomphocerus infuscatus*, Uhler, in Harr. Rep., 3d Edn., 181.

*Tragocephala infuscata*, Scudd., Bost. Jour. Nat. Hist., VII, 466.

3. *Variety radiata*, Harr.

*Locusta radiata*, Harr. Cat., 56.

*Tragocephala radiata*, Harr. Rep., Ed. 1862, 183.

*Gomphocerus radiatus*, Uhler, in Harr. Rep., 181.

The green variety (*virginiana*) is very common throughout the state, the female being apparently more abundant than the male; on the other hand, the male of the dusky or brown variety (*infuscata*) appears to be much more abundant than the female of that variety. It is this male that greets us first in the spring with his crackling notes. Variety *radiata* is occasionally met with in the southern and central parts of the state, and probably in the northern sections also.



19. *Tomonotus sulphureus*, FABR.1. *Variety sulphureus*, Fabr.

*Gryllus sulphureus*, Fabr. Syst. Ent., II, 59.

(*Loeusta*) *sulphureus*, Gmel. Linn., Syst. Nat. I, 2079.

*Acridium sulphureum*, Oliv. Encey. Meth. Ins., VI, 227.

*Oedipoda sulphurea*, Burm. Hanb. Ent., II, 643.

*Loeusta sulphurea*, Harr. Rep., 177, Pl. I, Fig. 6.

*Tomonotus sulphureus*, Sauss., Rev. et Mag. Zool., XIII, 1861, 321.

*Arphia sulphurea*, Stal. Recons. Orthop., I, 119.

2. *Variety xanthopterus*, Burm.

*Oedipoda xanthoptera*, Burm. Hanb. Ent., II, 643.

*Acridium xanthopteron*, De Haan. Bijdr. Kenn. Orth., 143.

*Tomonotus xanthopterus*, Thos. Synop. Acrid., 105.

*Arphia xanthoptera*, Seudd. Geol. Surv. N. Hamp., I, 377.

3. *Variety carinatus*, Seudd

*Oedipoda carinata*, Seudd. Trans. Am. Ent. Soc., II, 306.

*Tomonotus carinatus*, Thos. Synop. Acrid., 106.

The first and second varieties (*sulphureus* and *xanthopterus*) are found, I believe, throughout the state, though the former largely predominates, as far as my observations have gone; but there is such a complete gradation from one to the other in all the characters by which they are supposed to differ, that very often it is impossible to tell to which a specimen belongs. The variety *carinatus* is found only in the north-west part of the state.

20. *T. tenebrosus*, SCUDD.

*Oedipoda tenebrosa*, Seudd. Hayden's, Geol. Surv. Neb., 251.

*Tomonotus pseudo-nietanus*, Thos. Proc. Acad. Nat. Sci. Phila., 1870, 80.

*tenebrosus*, Thos. Syn. Acrid., 107.

*Arphia sanguinaria*, Stal, Recons. Orth., I, 119,

*tenebrosa*, Seudd. Bul. U. S. Geol. Surv., 1876.

This is occasionally seen in the extreme north-western part of the state; I have seen but one specimen collected in the state, and that was by Miss E. A. Smith, of Peoria.

21. *Spharagemon aequalis*, SAY.

*Gryllus aequalis*, Say., Jour. Acad. Nat. Sci. Phila., IV, 307.

*Loeusta aequalis*, Harr. Rep., 583

*Oedipoda aequalis*, Eriehs., Archiv. f. Nat., IX, 230.

*Trimerotropis aequalis*, Seudd., Geol. Surv. N. Hamp., I, 377.

*Spharagemon aequale*, Seudd., Proc. Bost. Soc. Nat. Hist., XVII, 1874-5.

This species is found throughout the greater part of the state, yet

many Illinois specimens referred to it do not belong to the species. I think *Trimerotropis verruculata*, although placed by Mr. Scudder in a different genus, is in fact but a variety of this species; yet as there is some doubt on this point I give them as distinct.

22. *S. collare*, SCUDD.

*Oedipoda collaris*, Scudd., Geol. Surv. Neb., 250.

*Spharagemon collare*, Scudd., Proc. Bost. Soc. Nat. Hist., XVII, 1874-5.

Has been taken in the northern part of the state, but I am inclined to think it is very rare.

23. *Trimerotropis verruculata*, KIRBY.

*Locusta verruculata*, Kirby, Faun. Bor. Am. Ins., 250.

*latipennis*, Harr. Rep., 179.

*Aceridium verruculatum*, De Haan, Bijdr. Kenn. Orth., 250.

*Oedipoda latipennis*, Uhler., Harr. Rep., 178.

*Trimerotropis verruculata*, Scudd., Geol. Surv. N. Hamp., 1, 377.

Limited chiefly to the northern section, but has been obtained in the southern.

24. *Encoptolophus sordidus*, BURM.

*Oedipoda sordida*, Burm., Hanb. Ent., II, 643.

*Aceridium (Oedipoda) sordidum*, De Haan. Bijdr. Kenn. Orth., 143.

*Locusta nebulosa*, Harr., Rep., 181.

*Oedipoda nebulosa*, Erichs, Archiv. f. Nat. II, 230.

*Locusta perisceelidis*, Harr, Cat., 56.

*Tragocephala sordida*, Stal., Recens. Orth., I, 119.

*Encoptolophus sordida*, Scudd., Proc. Bost. Soc. Nat. Hist., XVII, 1874-5.

Found occasionally throughout the state.

25. *Oedipoda carolina*, LINN.

*Gryllus (Locusta) carolina*, Linn, Syst. Nat. I., 701.

*carolinus*, Fab., Ent. Syst., II, 58.

*Aceridium carolinum*, Deg., Ins., III, 491, Pl. 41, Figs. 2 & 3.

*carolinum*, Pal. Beav., Ins., 147, Pl. 4, Fig. 6.

*Locusta carolina*, Harr. Rep., 176, Pl. 3, Fig. 3.

*caroliniana*, Catesby, Nat. Hist. Car., II, 89, Tab. 89.

Common throughout the state.

26. *Oe. neglecta*, THOS.

*Oedipoda neglecta*, Thos., Proc. Acad. Nat. Sci., Phila., 1870, 84.

*Hippiscus neglectus*, Scudd, Bull. Geol. Surv. Terr., Vol. II, No. 3, 1876, 264.

I have captured this species in southern Illinois, but think it is very rarely found here.

27. *Oe. belfragii*, STAL, *Recens. Orth.*, I, 129.

As this species is described by Stal as new and as coming from Illinois, I give here his description in full for the benefit of Illinois naturalists :

"Fuscous-brown; the head variegated with cinereous; earina of the head and of the posterior femora, also the posterior margin of the pronotum sprinkled with black; antennae annulated with fuscous. Pronotum with the posterior margin acute-angled; crest somewhat prominent, profoundly incised between the lobes. Elytra pale grayish-brown, somewhat translucent toward the apex, where they are also clouded with fuscous. Wings pale yellow at base, with a broad black band across the disk arcuate and narrowed internally; apex transparent, with fuscous veins. Anterior legs sub-annulated with fuscous; posterior femora with the fascia and apex black, the inferior margin and exterior side hairy; posterior tibiae pale yellowish, fuscous at the base, spine tipped with black, hairy. Female, length, 25 millimeters. Illinois.

"In the structure of the head and pronotum similar to *Oe. carolina*, but differs in being smaller, the elytra and wings less ample, and the former less densely reticulated; the pronotum behind the middle being sub-alutaceous; and in the color of the wings. The posterior angle of the lateral lobe of the pronotum rounded."

I am unacquainted with this species, and think the locality given is a mistake, or that it is a variety of some of the trans-Mississippi species which occasionally visit Illinois.

28. *Mestobregma? cineta*, THOS.

*Oedipoda cineta*, Thos., *Proc. Acad. Nat. Sci., Phila.*, 1870, 80.

I have taken a few specimens of this species in southern Illinois, but it is by no means common. I place it in this genus with doubt.

29. *Hippiscus corallipes*, HALD

*Oedipoda corallipes*, Hald., *Stansb. Rep. Salt Lake*, Pl. X, Fig. 2.

*Hippiscus corallipes*, Seudd. *Bull. Geol. Surv. Terr.*, 1876, II, 264.

*Oedipoda rugosa*, Seudd. *Bost. Jour. Nat. Hist.*, VII, 469.

*Hippiscus rugosus*, Seudd. *Geol. Surv. N. Hamp.*, I, 377.

*Oedipoda paradoxa*, Thos. *Geol. Surv. Terr.* 1871, 457.

(*Hippiscus paradoxus*.)

*Oedipoda haldemanii*, Seudd. *Geol. Surv., Neb.*, 251.

*Hippiscus haldemanii*, Seudd. *Bull. Geol. Surv. Terr.*, 1876, II, 264.

A close study of these forms for a number of years has satisfied me that they are all varieties of one species. The specimens found in Illinois are chiefly of the variety *rugosus*; but I find some which approach very near to *paradoxus*, with red or partly red wings.

30. *Hip. discoidens*, SERV.

*Oedipoda discoidea*, Serv. Hist. Orthop., 724.

*Aceridium tuberculatum*, Pal. Beauv., Ins., 145, Pl. 4, Fig. 1.

*Hippiscus discoidens*, Stal. Recens. Orth., I, 121.

This is occasionally met with in the extreme southern part of the state, Union county being as far north as I have positive evidence of its being found.

31. *Hip. phoenicopterus*, GERM.

*Locusta apiculata*, Harr. Cat., 56.

*corallina*, Harr. Rep., 176.

*Aceridium phoenicopterus*, De Haan. Bijdr. Kenn. Orth., 144.

*Oedipoda phoenicoptera*, Germ., Burm. Handb. Ent., II, 643.

*obliterata* ? Germ., Burm. Handb. Ent., II, 643.

*corallina*, Erichs. Archiv. f. Nat., IX, 229.

*Hippiscus phoenicopterus*, Scudd. Geol. Surv. N. Hamp. I, 377.

Found occasionally in various parts of the state; but by no means common.

32. *Camnula pellucida*, SCUDD.

*Oedipoda pellucida*, Scudd. Bost. Jour. Nat. Hist., VII, 472.

*atrox*, Scudd. Geol. Surv. Neb., 253.

*Camnula tricarinata* ? Stal. Recens. Orth., I, 120.

*pellucida*, Scudd. Geol. Surv. N. Hamp., I, 378.

I have never, that I am aware of, met with this species in Illinois, but find this locality given by Mr. Scudder in the Geological Survey of New Hampshire.

*Group* ACRIDINI.

33. *Pezotettix unicolor*, THOS. Synop. Acrid., 151.

Found in southern, and probably in central, Illinois.

34. *Pez. minutipennis*, sp. nov.

*Female*. Head short, eyes approximate above; the vertex very narrow between them, suddenly expanding to lateral angles just in front of them, slightly, sometimes scarcely, sulcate. Face, seen from the side, oblique and arcuate; frontal costa somewhat prominent, continuous nearly or quite to the clypeus, sides parallel, not, or but very slightly, sulcate. Pronotum cylindrical, the median carina distinct, though it is but a very slender line; lateral carina wholly obliterated; sides nearly parallel, expanding very slightly posteriorly; anterior margin squarely truncate; posterior margin truncate, with a slight notch at the middle, sometimes scarcely distinct; the posterior transverse incision is situated much behind the middle, reducing the posterior lobe to but one-third the length of the pronotum; the posterior lateral angle rounded, and the margin from thence up to the middle rounded



with no inward curve or notch except the one at the middle of the dorsum. Elytra minute, not meeting on the back, the space between them being more than the width of one of them; narrow, spatulate, width about one-third the length; extending over the second abdominal segment; longitudinal nerves prominent and similar. Abdomen somewhat prominent and carinated at the base, but suddenly decreasing in size posteriorly, so that near or a little beyond the middle it becomes cylindrical. Anterior femora slender; posterior femora about as long as the abdomen; upper carina distinct, and the upper external angle distinct and somewhat sharply defined; the tibiae distinctly expanding below. Prosternal spine broad at base, transverse, bluntly rounded at the tip.

*Color.* Head and thorax varying in different individuals from dull greenish-white to brown, with a clearly defined shining black line extending, on each side, from the eye to the posterior margin of the pronotum. Posterior femora bright pea-green, unspotted, except the tip, which is black; tibiae greenish, with the spines black.

*Male.* Much smaller than the female; eyes very prominent, and so closely approximate above that the portion of the vertex between them is reduced to a mere thread; the antennae comparatively large and reaching back to about the tip of the second abdominal segment. Tip of the abdomen strongly curved upward: cerci somewhat elongate, slender, and narrowed in the middle; tip of the last ventral segment somewhat conical, entire. Face quite oblique and arcuate.

*Color (of the single specimen.)* Face and disk of the pronotum dull ash-brown; cheeks and space of the pronotum below the black stripe pale ash-brown or rufous; posterior femora greenish-yellow, deeply tinged with bright-rufous above.

*Dimensions.*—Female, length .90 inch; male, length .65 inch.

Two females and one male, taken by Prof. Forbes, of Normal, in September.

I have given this as a distinct species, but confess I have very little expectation that most of the recently described western species of *Pezotettix* and *Caloptenus* will withstand the test of future investigations. It is more than probable that this will prove to be but a variety of Mr. Smith's *Pez. manca*. This species, or variety, as it may prove to be, appears to be an intermediate link between *Pez. manca*, Sm., and *Pez. alba*, Dodge, the former of Maine, the latter of Nebraska.

35. *Pez. scudderi*, UHLER. Proc. Ent. Soc. Phila., II, 555.

This is given on the authority of Mr. Uhler, who states that he received it from Rock Island, through Mr. Walsh. I am not acquainted with it, but have before me some specimens received from Prof. Forbes, taken at Normal, which I am inclined to refer to it. They differ from

Uhler's description as follows: The black stripe on the side of the female pronotum is distinct and broad; whitish spots on the metathorax distinct in the male; posterior femora yellow or greenish-yellow, with distinct oblique dark bands; posterior tibiae pale.

36. *Pez. viola*, sp. nov.

*Female*. Rather large and robust, caloptenoid in appearance, and resembling somewhat *Pez. dodgei*. Vertex and frontal costa not, or but slightly, sulcate. Pronotum with the median carina slight; lateral carinae somewhat distinct; sides flattened; posterior margin rounded; posterior lateral margins with a distinct inward curve or rounded notch at the humerus, the portion below the notch perpendicular. Elytra ovate-lanceolate, the externo-median nerve distinct, not always meeting at the base, but overlapping more or less toward the apex; varying in length from about one-third to more than one-half that of the abdomen.

*Color*. Varying from a dull olive-brown to ash-brown. Head and thorax brown; elytra with the upper (or inner) half pale brown, lower (outer) half dark-brown or black, one or two dots sometimes broken off the black at the tip; posterior femora reddish with oblique brownish bands; posterior tibiae rufous.

*Dimensions*. Length 1. to 1.1 inch.

Central and southern Illinois.

37. *Caloptenus femur-rubrum*, Deg.

*Acridium femur-rubrum*, Deg. Ins., III, 498, Pl. 2, Fig. 5.

femorale, Oliv. Encyc. Meth. Ins., VI, 228.

*Gryllus* (*Locusta*) *erythropterus*, Gmel. Linn. Syst. Nat., I, 2086.

*Caloptenus femur-rubrum*, Burm. Handb. Ent., II, 638.

*Pezotettix* (*Melanoplus*) *femur-rubrum*, Stal. Recens. Orthop., I, 79

Our most common species; found throughout the state.

38. *C. atlantis*, RILEY, 1st Rept., 1875, 169.

This is but a variety of the preceding species, and appears to be an intermediate link between *C. femur-rubrum* and *C. spretus*; but in some respects approaches *C. occidentalis*.

39? *C. spretus*, THOS. (The Rocky Mountain Locust.)

*Acridium spretum*, Thos. Trans. Ill. Ag. Soc., V, 450.

*Caloptenus spretus*, Thos. Synop. Acrid., 164.

A few stray specimens have perhaps been captured in Illinois, and hence I include it with a mark of doubt prefixed.

40. *Acridium differentiale*, THOS., Trans. Ill. Ag. Soc.; V, 450.

*Cyrtacanthacris differentialis*, Walk. Cat. Dermap. Salt., IV, 610.

*Caloptenus differentialis*, Thos. Proc. Acad. Nat. Sci. Phila., 1871.

Common throughout the state, and has occasionally been seen migrating.

41. *Acridium rubiginosum*, SCUDD.

*Acridium rubiginosum*, Scudd., Bost. Jour. Nat. Hist., VII, 467.  
*damnificum*, Sauss. Rev. et Mag. Zool., XIII, 1861, 164.

Occasionally met with in southern Illinois, in the oak regions.

42. *A. emarginatum*, SCUDD. Geol. Surv. Neb., 240.

I have seen but a single Illinois specimen, which was captured by Prof. Forbes, at Normal.

43. *A. americanum*, DRURY.

*Gryllus americanus*, Drury, Ill., II, 3, 128, Pl. 49, Fig. 2, 1770.  
*succinctus*, Linn. Syst. Nat., 12th Ed., I, 699, 1767.  
*serialis*, Thunb. Mem. Acad. Pet., V, 241, 1815.

*Locusta tartarica*, West. in Drury Ill., I, 121.

*Acridium americanum*, Scudd., Bost. Jour. Nat. Hist., VII, 466.  
*rusticum*, Glov. Ill., Pl. 1, Fig. 15.

(*Schistocerca*) *americanum*, Stal. Recens. Orth., I, 66.  
*ambiguum*, Thos. Synop. Acrid., 173.

Common in southern Illinois, and occasionally found as far north as Normal and Champaign.

*Sub-fam.* TETTIGINAE.

*Group* TETTIGINI.

44. *Tettix ornata*, SAY.

*Aerydium ornatum*, Say. Am. Ent., I, 10, Pl. V, Fig. 1.

*Tetrix arenosa*, Burm. Handb. Ent., II, 659.

*dorsalis*, Harr. Rep., 186.

*quadrinaculata*, Harr. Rep., 186.

*bilineata*, Harr. Rep., 186.

*sordida*, Harr. Rep., 187.

*Tettix ornata*, Scudd. Bost. Jour. Nat. Hist., VII, 474.

45. *Tettigidea lateralis*, SAY.

*Aerydium laterale*, Say. Am. Ent., Pl. V, Figs. 2 & 3.

*Tetrix lateralis*, Harr. Rep., 187.

*Tettigidea lateralis*, Scudd. Bost. Jour. Nat. Hist., VII, 477.

46. *T. polymorpha*, BURM.

*Tetrix polymorpha*, Burm. Handb. Ent., II, 659.

*parvipennis*, Harr. Rep., 187, Fig. 82.

*Tettigidea polymorpha*, Scudd. Bost. Jour. Nat. Hist., VII, 477.





## EXPLANATION OF THE PLATES.

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### ILLINOIS CRUSTACEA.

- 1, 2, 3, 4, 5, 6, 7, *Crangonyx mucronatus*, Forbes.
1. Head of female, with pedicels of antennae.
  2. Posterior abdominal segments of male, with their appendages.
  3. One of 1st pair of hands of male.
  4. One of 2d pair of hands of male.
  5. Telson and last pair of stylets of female.
  6. One of 1st pair of hands of female.
  7. One of 2d pair of hands of female.
- 8, 9, 10, 11, *Asellus brevicauda*, Forbes.
8. Hand of male,  $\times 20$ .
  9. One of 1st pair of genital plates of male,  $\times 38$ .
  10. One of 2d pair of genital plates of male,  $\times 19$ .
  11. One of caudal stylets.
- 12, 13, 14, 15, 16, *Asellus intermedius*, Forbes.
12. Hand of male,  $\times 45$ .
  13. Hand of female.
  14. Last segment of abdomen, with caudal stylets,  $\times 17$ .
  15. One of 1st pair of genital plates of male,  $\times 38$ .
  16. One of 2d pair of genital plates of male,  $\times 38$ .
- 17, 18, *Asellus communis*, Say.
17. One of 1st pair of genital plates of male,  $\times 18$ .
  18. One of 2d pair of genital plates of male,  $\times 18$ .
- 19, 20, *Asellus stygius*, Pack.
19. One of 1st pair of genital plates of male.
  20. One of 2d pair of genital plates of male.
- 21, 22, 25, *Eubbranchipus serratus*, Forbes.
21. Abdomen,  $\times 3$ .
  22. Frontal appendage of male,  $\times 10$ .
  25. Claspers of male, from before,  $\times 6$ .

23, 26, 27, 31, *Canthocamptus illinoisensis*, Forbes

- 23. One of 5th pair of legs of female.
- 26. One of anterior maxillipeds,  $\times$  250.
- 27. One of 3d pair of legs of male.
- 31. One of posterior maxillipeds.

24, 28, 29, 30, *Diaptomus sanguineus*, Forbes.

- 24. One of posterior maxillipeds.
- 28. One of anterior maxillipeds,  $\times$  66.
- 29. 5th pair of legs of male.
- 29a. Tip of inner ramus of left leg.
- 30. One of 5th pair of legs of female.

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## PARASITIC FUNGI.

### PLATE I.

1, 2, 3 & 4, *Cystopus candidus*, Lev.

- 1. Portion of cabbage leaf with spots and holes caused by fungus.
- 2. Conidia, magnified 360 diam. After Cooke.
- 3a. Oogonium; 3b, antheridium; 3c, oospore, magnified 400 diam.
- 4. Oospore (the developed oosphere) ruptured, exhibiting zoospores, magnified 400 diameters. After De Barry.
- 4a. Free zoospores from oospore. 3 & 4 after De Barry.

5, 6, 7, 8, 9, 10 & 11, *Undetermined Parasite on Green-house Plants*.

- 5. Portion of petiole of geranium, with fungus; natural size.
- 6. Fertile hyphæ and conidia, magnified about 175 diam.
- 7. Conidium magnified 650 diam
- 8. Conidium twelve hours after sowing in water, outer coat ruptured and the inner protruding in the form of a tube, magnified 320 diam
- 9. Same conidium, thirty hours after sowing, magnified 325 diam.; germinating tube issuing from two points.
- 10. Supposed oospore, (see text) magnified 390 diam.
- 11. Longitudinal section of stem of *Achyranthus*, with mycelium, especially following the vascular bundles, a. Also seen penetrating cells of pith, c.

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### PLATE II.

- 1. *Melanispora populina*, Lev. a, Portion of leaf of *Populus monilifera*, natural size; b, Summer spores.
- 2. *Botryopium pulchrum* (?) Corda. Magnified about 75 diam.

3. *Peronospora gangliiformis*, Berk. Lettuce mould.
4. *Microsphæria elevata*, n. sp. On leaves of *Catalpa bignonioides*; magnified 75 diam.
5. Sporangia of same.
6. *Peronospora viticola*, B. & C. On grape leaves.
7. Mycelium of same, with haustoria in pith of young stem.; magnified 350 diam.
8. *Peronospora infestans*, Mont. Magnified 350 diam.

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PLATE III.

1. Section of leaf of *Pinus austriaca*, with *Pestalozzia* ———. Magnified 20 diam. The leaves are probably dying from some other fungus.
- 1a. Spores of same, magnified 85 diam.
2. *Podosphæra kunzei* (?) Lev. On cultivated cherry leaves; magnified 75 diam.
- 2a. Sporangium of same.
- 2b. Macrosporium-like or capnodium-like bodies on appendages.
- 2c. Appendage having moniliform divisions.
- 2d. Similar to c. Found mostly on mycelium.
3. *Sphærotheca castagnei* (?) Lev. On *Erechtites hieracifolus*; magnified 75 diam.
4. Sporangia of same.
5. *Rhytisma acerinum*, Fr. On leaf of *Acer dasycarpum*; natural size.
6. Vertical section of same. c. Asci with young spores.
7. Pleynidia of an *Erysiphe* on *Verbena urticifolia*.
- 7f. Macrosporium-like forms found with latter.

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PLATE IV.

1. *Erysiphe*, ———. On *Aster puniceus*.
2. *Microsphæria extensa*, C. & P. On *Quercus rubra*; magnified 75 diam.
3. Appendage, magnified 300 diam.
4. Ruptured conceptacle of same; a. sporangia.
5. Triposporium-like bodies on same mycelium.
6. *Phylactinia guttata*, Lev. On *Fraxinus viridis*.
- 7, 8, 9, 10 & 11. *Microsphæria ravenelii*, Berk. On *Gleditchia triacanthos*.
12. Macrosporium-like bodies, with *Microsphæria fresii*, Lev. On leaves of *Syringa vulgaris*.

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THE TREE IN WINTER.

PLATE I.

1. *Aesculus glabra*, Willd. Buckeye.
2. *Acer saccharinum*, Wang. Sugar maple.
3. *Acer dasycarpum*, Ehrh. Soft maple.

4. *Negundo aceroides*, Moench. Box elder.
5. *Staphylea trifolia*, L. Bladder nut.
6. *Euonymus atropurpureus*, Jacq. Burning bush.
7. *Sambucus canadensis*, L. Elder.
8. *Fraxinus americana*, L. White ash.
9. *Fraxinus pubescens*, Lam. Red ash.
10. *Fraxinus viridis*, Michx., f. Green ash.
11. *Fraxinus sambucifolia*, Lam. Black ash.
12. *Fraxinus quadrangulata*, Michx. Blue ash.
13. *Viburnum lentago*, L. Sheep berry.
14. *Viburnum dentatum*, L. Arrow wood.
15. *Cornus paniculata*, L'Her. Panicle cornel.
16. *Lonicera flava*, Sims. Yellow honeysuckle.
17. *Tecoma radicans*, Juss. Trumpet-creeper.
18. *Catalpa bignonioides*, Walt. Indian bean.
19. *Cephalanthus occidentalis*, L. Button bush.
20. *Rhamnus laccolatus*, Pursh. Buck-thorn.
21. Horizontal cut of the bud of *Fraxinus sambucifolia*.
22. Horizontal cut of the bud of *Acer dasycarpum*.
23. Horizontal cut of the bud of *Staphylea trifolia*.
24. Horizontal cut of the bud of *Cornus paniculata*.
25. Horizontal cut of the bud of *Euonymus atropurpureus*.

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PLATE II.

1. *Quercus alba*, L. White oak.
2. *Quercus macrocarpa*, Michx. Burr oak.
3. *Quercus bicolor*, Willd. Swamp white oak.
4. *Quercus prinus*, L. (Var. *acuminata*, Michx.) Chestnut oak.
5. *Quercus imbricaria*, Michx. Shingle oak.
6. *Quercus coccinea*, Wang. Scarlet oak.
7. *Quercus rubra*, L. Red oak.
8. *Quercus nigra*, L. Black-jack oak.
9. *Populus monilifera*, Ait. Cottonwood.
10. *Populus heterophylla*, L. Downy poplar.
11. *Populus grandidentata*, Michx. Large-toothed aspen.
12. *Populus tremuloides*, Michx. Aspen.
13. *Corylus americana*, Walt. Hazlenut.
14. *Fagus ferruginea*, Ait. Beech.
15. *Ostrya virginica*, Willd. Hop hornbeam.
16. *Carpinus americana*, Michx. Hornbeam.
17. *Juglans cinerea*, L. Bitternut.
18. *Juglans nigra*, L. Black walnut.
19. *Carya alba*, Nutt. Hickory.
20. *Carya tomentosa*, Nutt. Mockernut.
21. *Carya olivaeformis*, Nutt. Pecan.
22. *Carya amara*, Nutt. Bitternut.
23. *Liquidambar styraciflua*, L. Sweet gum.



## PLATE III.

1. *Gymnocladus canadensis*, Lam. Coffee-bean tree.
2. *Amorpha fruticosa*, L. False indigo.
3. *Platanus occidentalis*, L. Sycamore.
4. *Liriodendron tulipifera*, L. Tulip tree, (or wrongly, yellow poplar.)
5. *Dirca palustris*, L. Leatherwood.
6. *Nyssa multiflora*, Wang. Sour gum.
7. *Sassafras officinalis*, Nees. Sassafras.
8. *Lindera benzoin*, Meisn. Spice bush.
9. *Cornus alternifolia*, L. Alternate-leaved cornel.
10. *Rhus glabra*, L. Smooth sumach.
11. *Rhus toxicodendron*, L. Poison ivy.
12. *Rhus aromatica*, Ait. Fragrant sumach.
13. *Zanthoxylon americanum*, Mill. Prickly ash.
14. *Ptelea trifoliata*, L. Hop tree.
15. *Robinia pseudacacia*, L. Locust
16. *Gleditschia triacanthos*, L. Honey locust.
17. *Ribes rotundifolium*, Michx. Wild gooseberry.
18. *Ribes floridum*, L. Black currant.
19. *Crataegus tomentosa*, L. Black thorn.
20. *Prunus americana*, Marsh. Plum.
21. *Prunus serotina*, Ehrh. Black cherry.
22. *Pyrus coronaria*, L. Crab apple.
23. *Amelanchier canadensis*, Torr. & Gr. June berry.
24. *Salix discolor*, Muhl. Glaucous willow.
25. *Betula nigra*, L. Red birch.
26. *Diospyros virginiana*, L. Persimmon.
27. *Ilex verticillata*, Gr. Black alder.

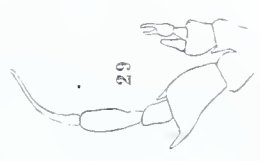
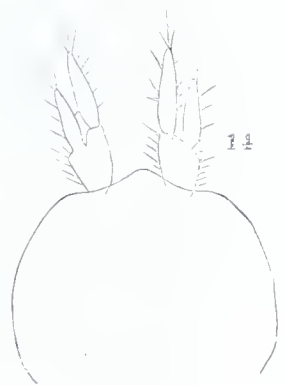
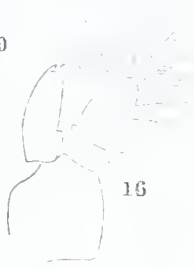
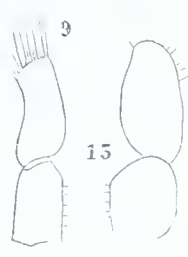
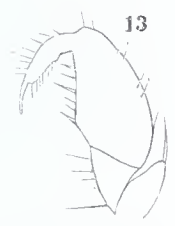
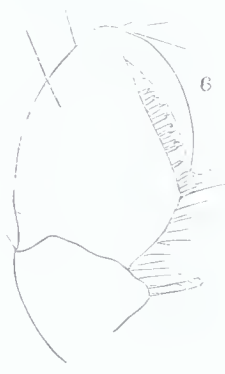
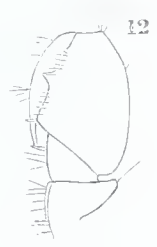
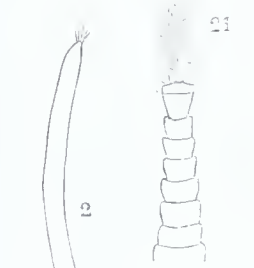
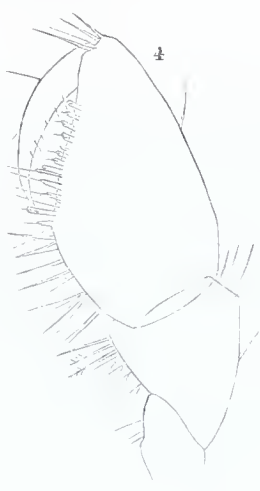
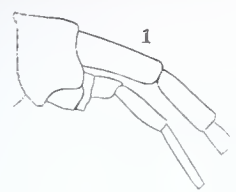
## PLATE IV.

1. *Asimina triloba*, Dun. Paw-paw.
2. *Tilia americana*, L. Linden.
3. *Morus rubra*, L. Mulberry.
4. *Ulmus fulva*, Michx. Slippery elm.
5. *Ulmus americana*, L. White elm.
6. *Ulmus alata*, Michx. Winged elm.
7. *Celtis occidentalis*, L. Hackberry.
8. *Cercis canadensis*, L. Red bud.
9. *Hamamelis virginica*, L. Witch hazel.
10. *Celastrus scandens*, L. Wax-work.
11. *Ampelopsis quinquefolia*, Michx. Virginia creeper.
12. *Vitis riparia*, Michx. Grape vine.
13. *Smilax hispida*, Muhl. Greenbrier.
14. Horizontal cut of the bud of *Ulmus*.

15. Horizontal cut of the bud of *Celtis*.
16. Horizontal cut of the bud of *Populus*.
17. Horizontal cut of the bud of *Crataegus*.
18. Horizontal cut of the leaf of *Carya alba*.
19. Diagram of the phyllotaxis of *Quercus*.
20. Diagram of the phyllotaxis of *Juglans*.
21. Diagram of the phyllotaxis of *Ptelea*.
22. Diagram of the phyllotaxis of *Amorpha*.

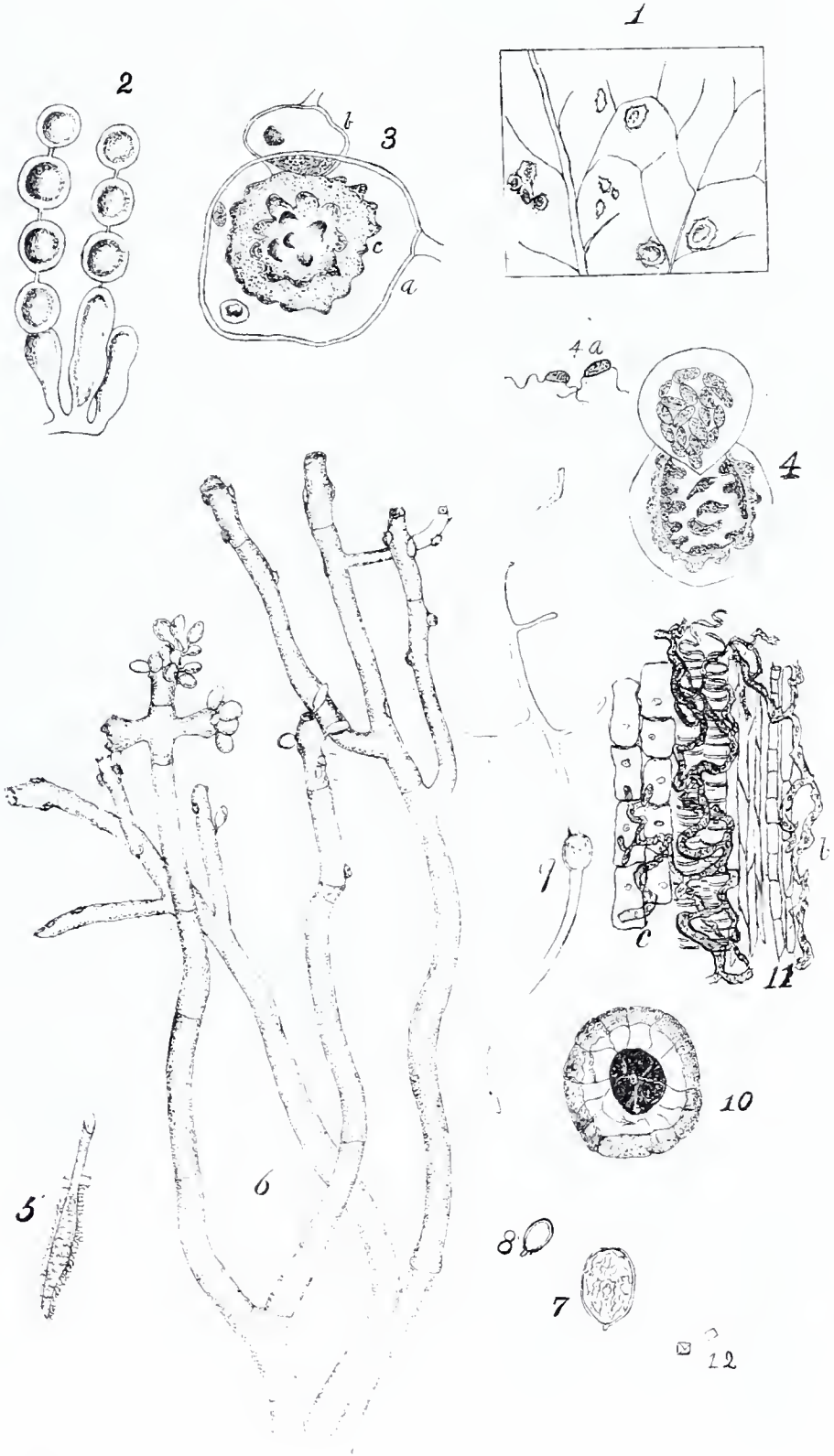
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NOTE.—In these drawings the chief characteristics of these species are exposed, but it must not be expected that every specimen compared with the figure must exactly agree; there is much variation in the form of the leaf-scars within certain limits in the form of the buds, in the pubescence, etc. Not every twig of the hazel is so glandular hairy as the figure shows, not in every twig of the blue ash or burning bush, do we find the wings as in our figures, these are often only faint lines.

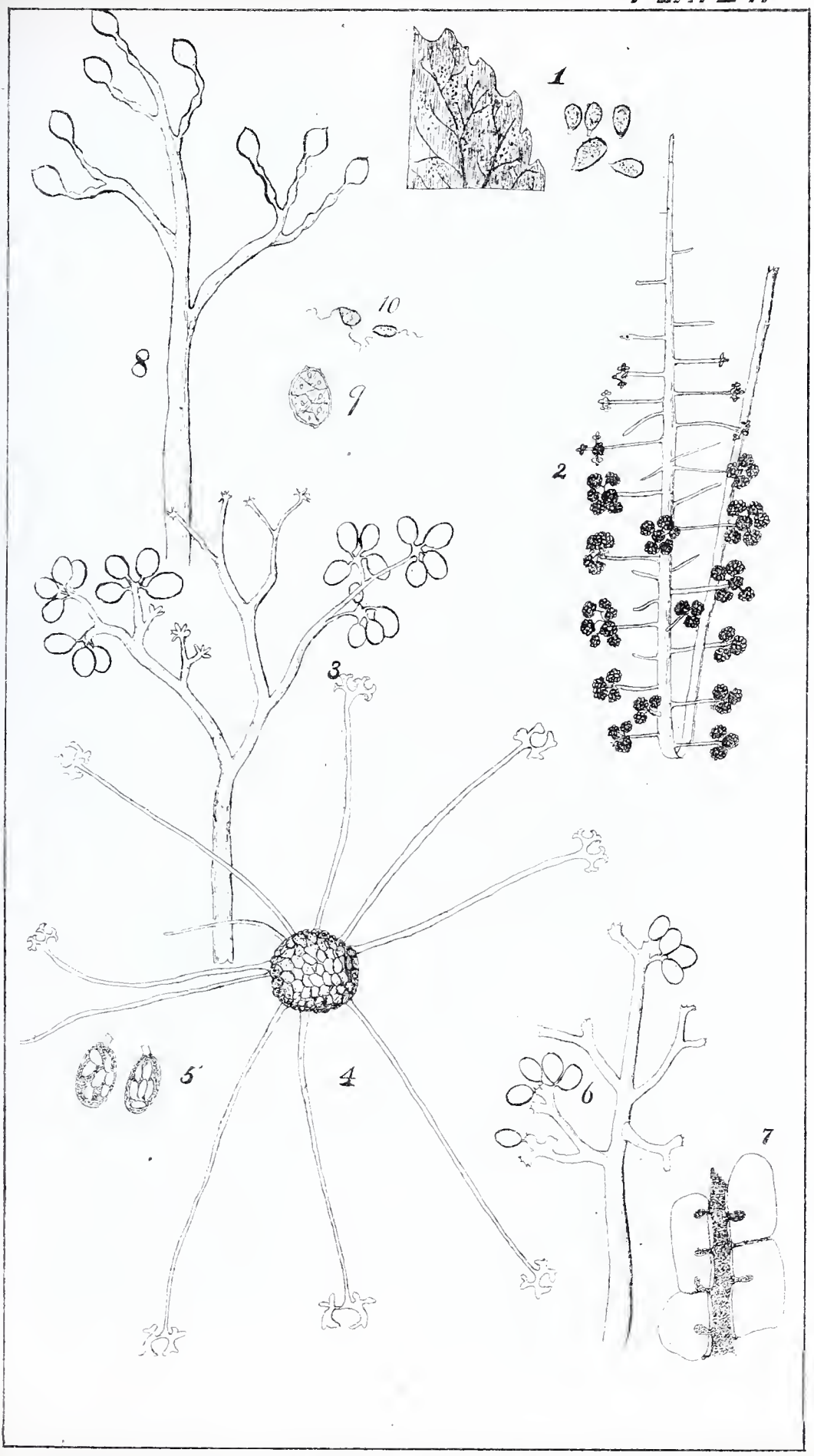




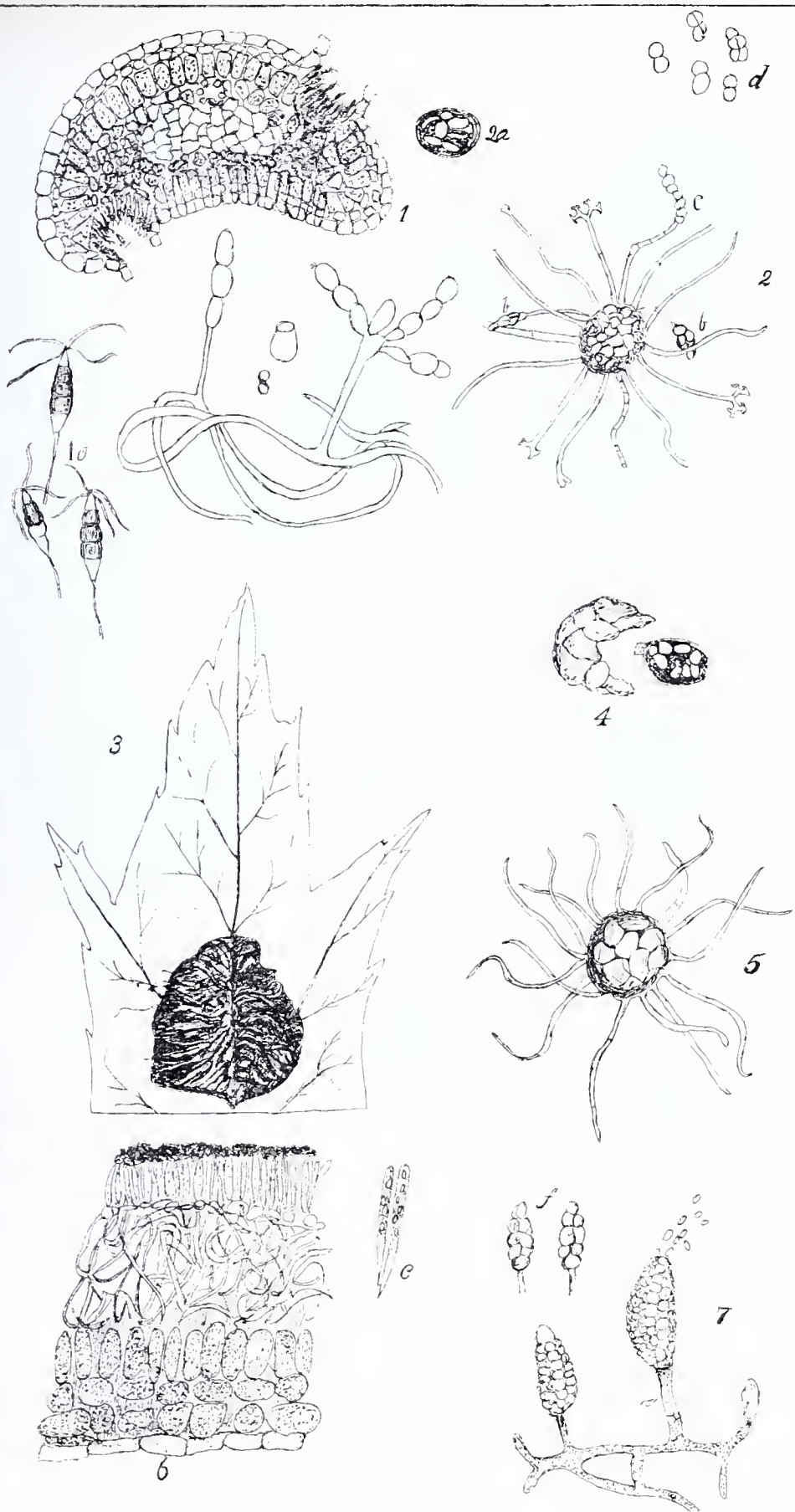






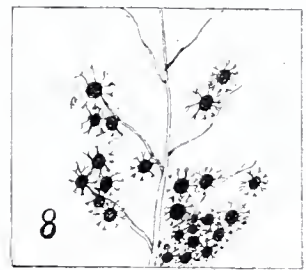
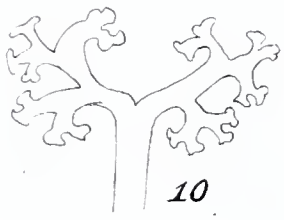
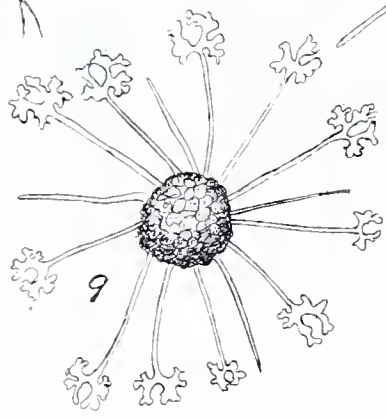
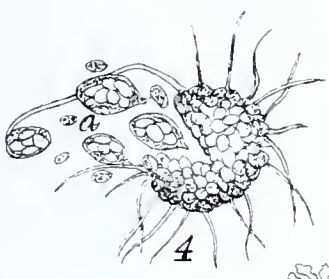
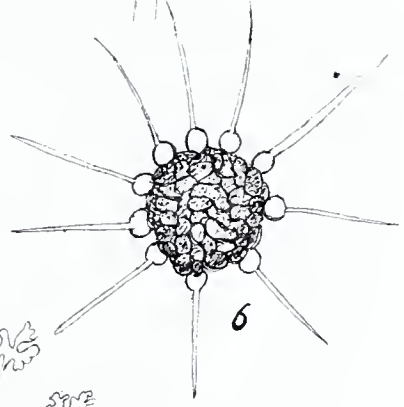
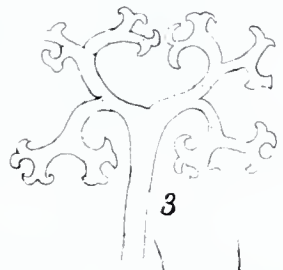
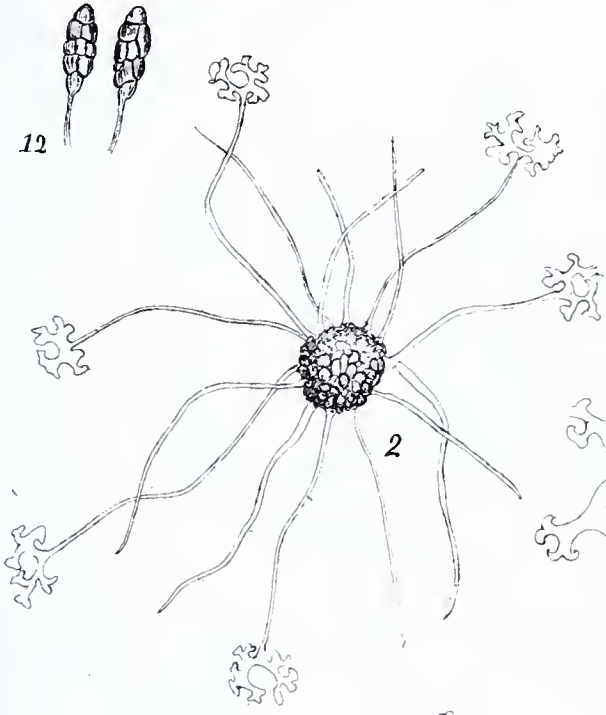
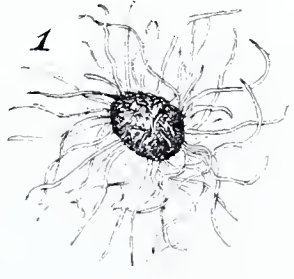












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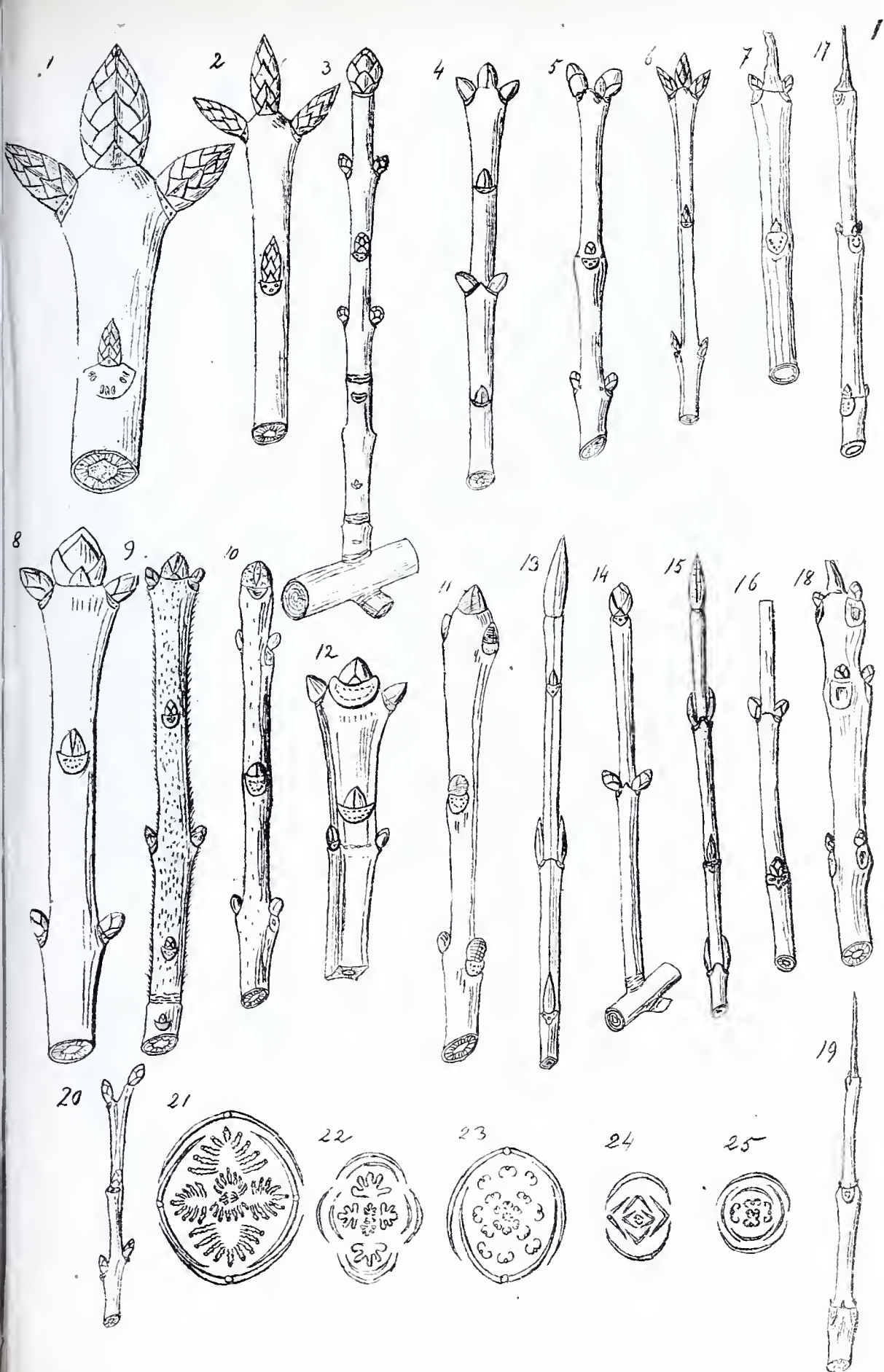
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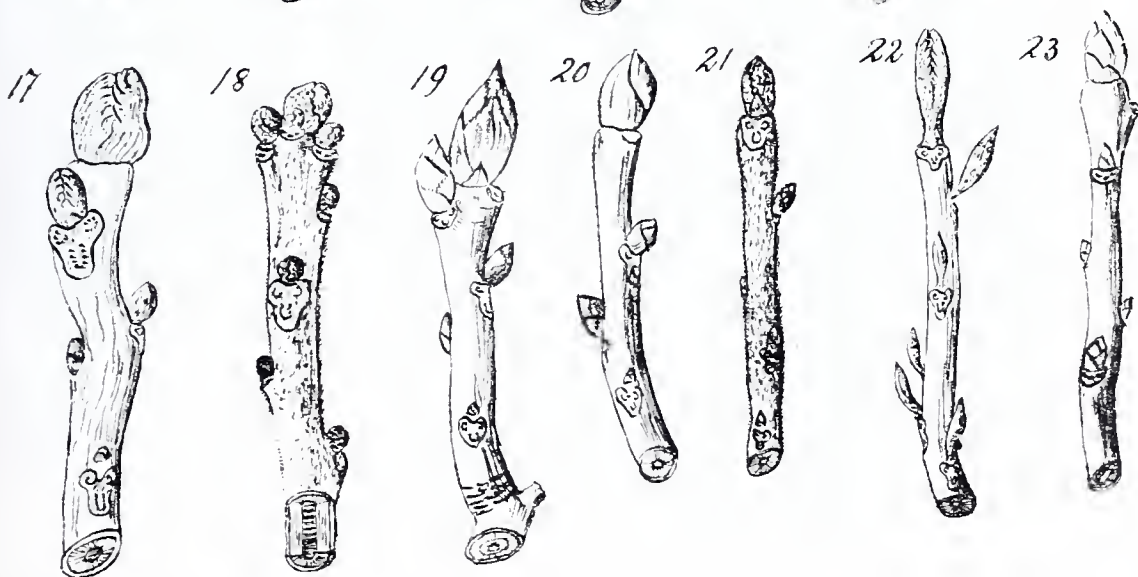
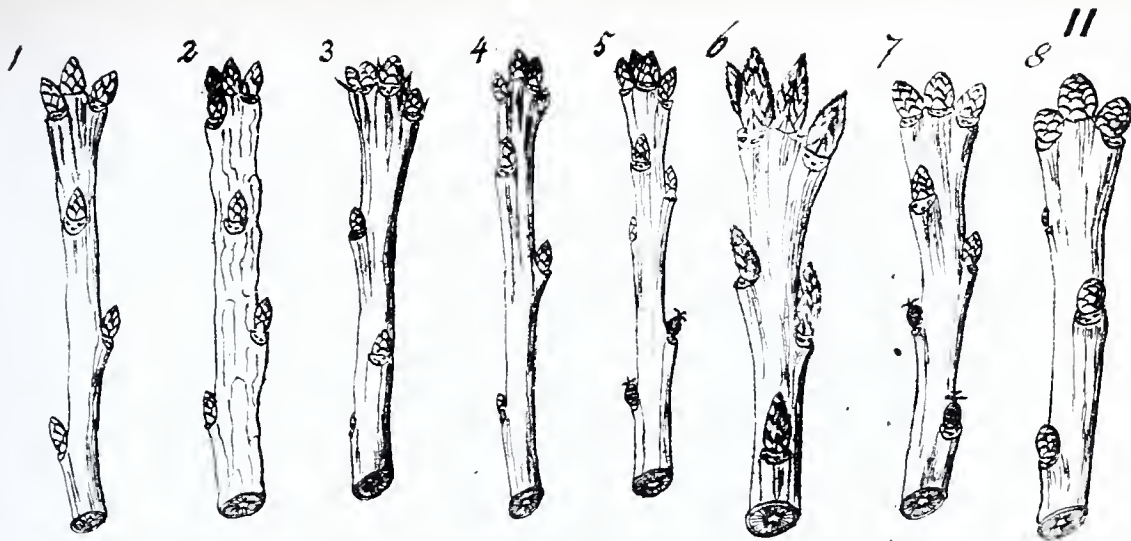
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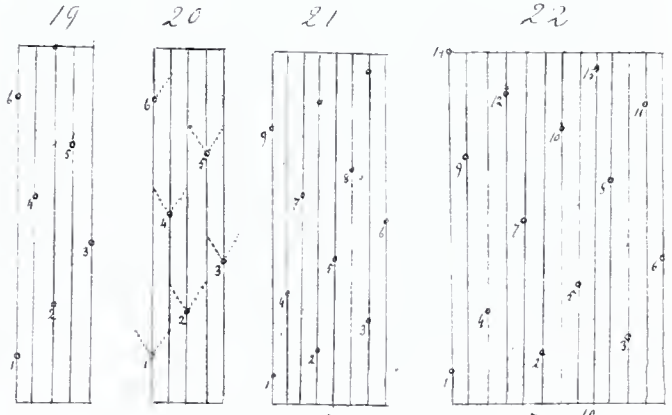
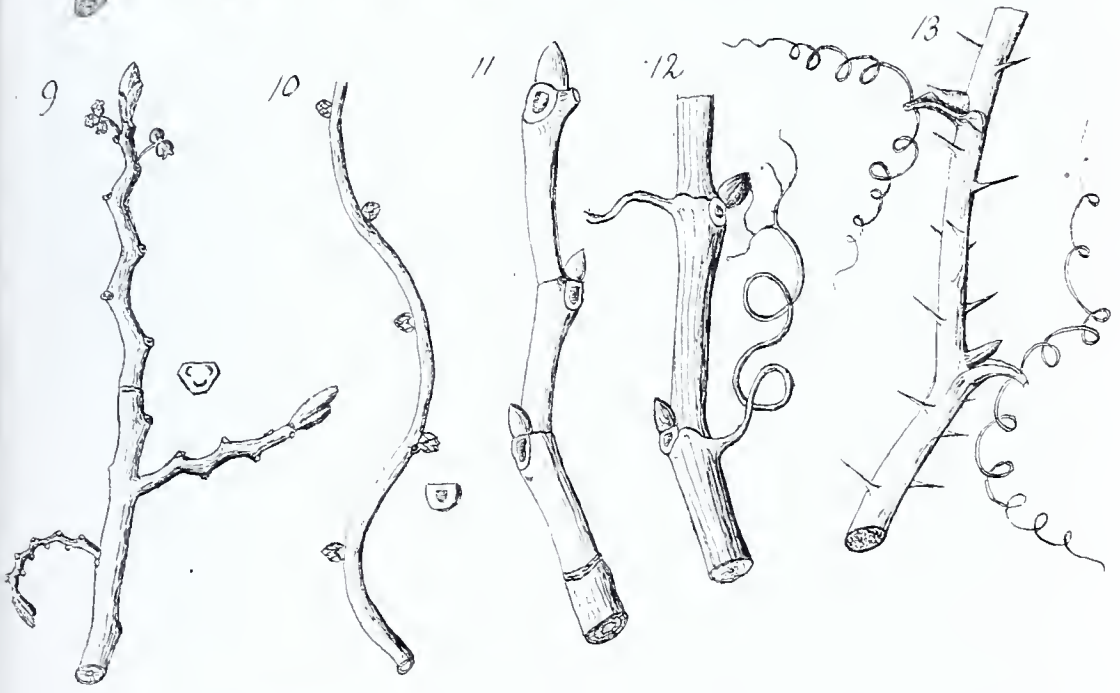
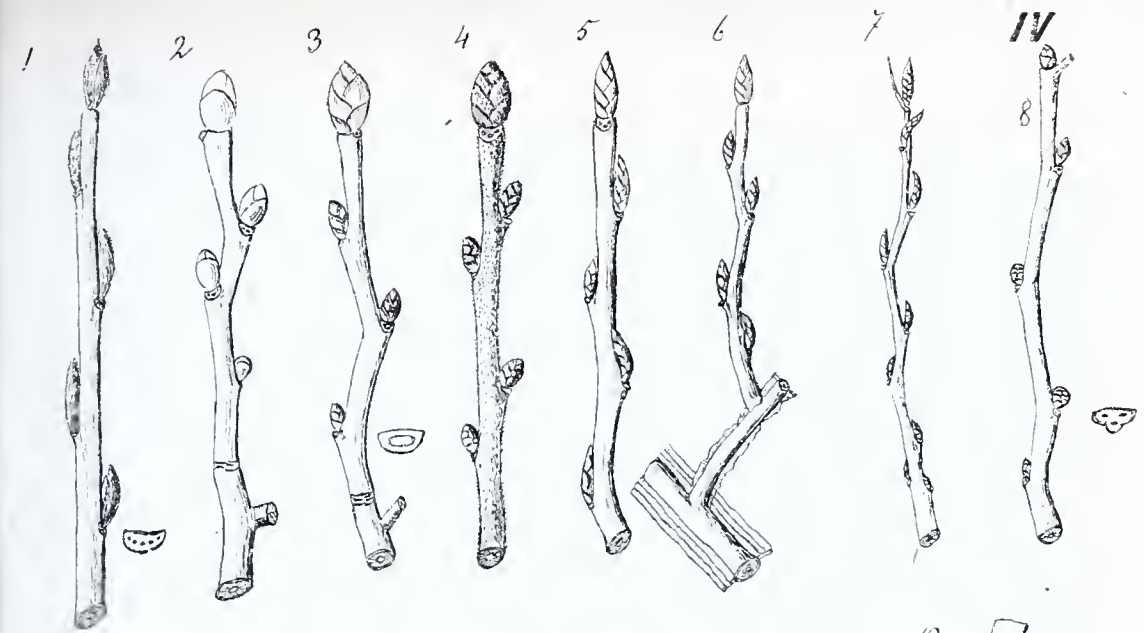




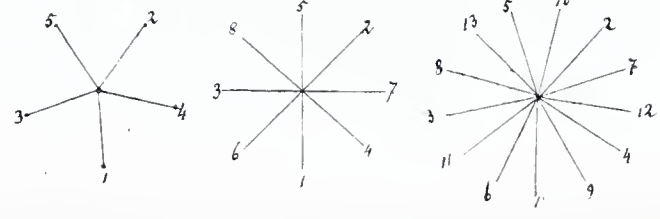








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